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# CONTRIBUTORS TO THIS NUMBER

- ADAMS, S. FRANKLIN, M. D. Assistant in Section in Division of Medicine<sup>1</sup>, Fellow in Medicine<sup>2</sup>
- ADSON, ALFRED W., B. S., M. D., M. A., M. S. in Surgery, F. A. C. S. Head of Section on Neurologic Surgery<sup>1</sup>, Assistant Professor in Surgery.<sup>3</sup>
- BALFOUR, DONALD C., M. D., F. A. C. S. Head of Section in Division of Surgery<sup>1</sup>, Chief of Department of Surgery<sup>2</sup>, Professor of Surgery<sup>2</sup>
- BENEDICT, WILLIAM L., M. D., F. A. C. S. Head of Section on Ophthalmology<sup>1</sup>, Professor of Ophthalmology.<sup>3</sup>
- BERKMAN, DAVID M., B. S., M. D., M. S. in Medicine. Head of Section in Division of Medicine<sup>1</sup>, Assistant Professor in Medicine<sup>2</sup>
- BOWING, HARRY H., B. S., M. D. Head of Section on Radium Therapy<sup>1</sup>, Instructor in Radiology<sup>2</sup>
- BRAASCH, WILLIAM F., B. S., M. D., F. A. C. S. Head of Section on Urology<sup>1</sup>; Professor of Urology<sup>2</sup>
- BROWN, PHILIP W., B. A., M. D.: Assistant in Section in Division of Medicine<sup>1</sup>, Fellow in Medicine<sup>2</sup>
- BUIE, LOUIS A., B. A., M. D. Associate in Section on Medicine<sup>1</sup>, Instructor in Medicine.<sup>2</sup>
- BUMPUS, HERMON C., JR., Ph. B., M. D., M. S. in Urology. Associate in Section on Urology<sup>1</sup>, Assistant Professor in Urology<sup>2</sup>
- DESJARDINS, ARTHUR U., M. D. Head of Section on Roentgen-ray Therapy<sup>1</sup>; Fellow in Roentgenology<sup>2</sup>
- FOULDS, GORDON S., M. B. (Tor), M. S. in Urology. Fellow in Urology<sup>2</sup>
- FRAZER, EMMETT B., B. S., M. D., M. S. in Surgery. Fellow in Surgery<sup>2</sup>
- HEDBLUM, CARL A., B. A., M. A., M. D., Ph. D. in Surgery, D. Sc., F. A. C. S. Head of Section in Division of Surgery<sup>1</sup>, Associate Professor of Surgery<sup>2</sup>
- HENDERSON, MELVIN S., M. B. (Tor), M. D., F. A. C. S. Head of Section on Orthopedic Surgery<sup>1</sup>; Professor of Orthopedic Surgery<sup>2</sup>
- HUNT, VERNE C., B. S., M. D., M. S. in Surgery, F. A. C. S. Head of Section in Division of Surgery<sup>1</sup>, Assistant Professor of Surgery<sup>2</sup>
- JUDD, E. STARR, M. D., F. A. C. S. Head of Section in Division of Surgery<sup>1</sup>, Professor of Surgery<sup>2</sup>
- KNIGHT, MARY S., M. D. Assistant in Section on Ophthalmology<sup>1</sup>, Fellow in Ophthalmology<sup>2</sup>
- LILLIE, HAROLD I., B. A., M. D., F. A. C. S. Head of Section on Otolaryngology and Rhinology<sup>1</sup>, Professor of Otolaryngology, Rhinology, and Laryngology<sup>2</sup>
- LYONS, JOHN H., B. S., M. D., M. S. in Surgery. Fellow in Surgery<sup>2</sup>
- MANN, FRANK C., B. A., M. A., M. D., Ph. D. in Surgery, D. Sc., F. A. C. S. Head of Section in Division of Surgery<sup>1</sup>, Assistant Professor of Surgery<sup>2</sup>
- NEW, GORDON B., D. D. S., M. B. (Tor), M. D., F. A. C. S. Head of Section on Laryngology, Oral and Plastic Surgery<sup>1</sup>, Professor of Rhinology, Laryngology, and Stomatology.<sup>2</sup>
- PEMBERTON, JOHN DEJ., B. A., M. D., M. S. in Surgery, F. A. C. S.: Head of Section in Division of Surgery<sup>1</sup>, Assistant Professor of Surgery.<sup>2</sup>
- SCHOLL, ALBERT J., B. A., M. D., M. S. in Urology. Assistant in Section in Division of Surgery<sup>1</sup>, Fellow in Urology.<sup>2</sup>
- SIMPSON, WALTER C., B. S., M. D., F. A. C. S. Head of Section in Division of Surgery<sup>1</sup>; Assistant Professor of Surgery<sup>2</sup>
- STOKES, JOHN H., B. A., M. D. Head of Section on Dermatology and Syphilology<sup>1</sup>; Professor of Dermatology.<sup>2</sup>
- VINSON, ROBERT D., B. S., M. D., M. S. in Medicine. Assistant in Section in Division of Medicine<sup>1</sup>; Assistant in Section in Division of Medicine.<sup>2</sup>
- WILDER, RUSSELL M., B. S., Ph. D., M. D.: Head of Section in Division of Medicine<sup>1</sup>; Professor of Medicine<sup>2</sup>
- WILLIUS, FREDRICK A., B. S., M. D., M. S. in Medicine; Head of Section in Division of Medicine<sup>1</sup>, Assistant Professor of Medicine.<sup>2</sup>

<sup>1</sup> In the Mayo Clinic.

<sup>2</sup> On the Mayo Foundation for Medical Education and Research, Graduate School, University of Minnesota

S. M. S. Medical College, Jaipur.

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# THE SURGICAL CLINICS OF NORTH AMERICA

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## OBSTRUCTIONS OF THE ESOPHAGUS AND CARDIA, AND FOREIGN BODY IN THE BRONCHUS

PORTER P. VINSON

— — —

I WILL present seven cases illustrating various types of obstruction of the esophagus and cardia, and one case of foreign body in the bronchus, which necessitate surgical intervention. They are:

- Carcinomatous stricture of the esophagus
- Hysterical obstruction of the esophagus
- Recurrent cardiospasm
- Cardiospasm
- Foreign body (corn) in the bronchus
- Cicatricial stricture (two cases)
- Pharyngo-esophageal diverticulum

**Case I. Carcinomatous stricture of the esophagus.**—This man, seventy-one years of age, came to the Clinic about two months ago. He had had difficulty in swallowing for two weeks. The difficulty came on rather suddenly; in swallowing solid food, it seemed to stick in the lower end of the esophagus. He had had some distress in eating, and food was regurgitated. Since then he has had constant dysphagia, and his diet has consisted of soft and liquid foods. His general health is reasonably good.

If a man or woman more than forty years of age, without previous trauma to the esophagus, has a history of progressive dysphagia of less than one year's duration, first with solid foods,

and then gradual obstruction to soft foods and liquids, the condition is almost certain to be cancer. In making this diagnosis methods may be employed such as: (1) esophagoscopy with removal of a specimen for microscopic examination; (2) x-ray of the esophagus, which will usually afford a characteristic picture, revealing a moth-eaten appearance that is not present in any other condition, or (3) having the patient swallow a thread, then passing sounds, first to the stricture, measuring off the distance of the obstruction from the incisor teeth with a plain olive, and then a dilating olive through the stricture. With the first dilating olive passed, before trauma is produced, a pink tinged mucus will be noted on the guiding wire spiral, this is pathognomonic of cancer. An esophagoscopy examination is seldom necessary or practical in these cases, for very often, even though the condition is cancerous, a section may show only inflammatory changes. I have a man under observation now whose growth is covered by a fold of normal mucous membrane, therefore negative microscopic findings are not to be accepted as final. A combination of the second and third methods is used chiefly in the Clinic in making the diagnosis. First the esophagus is rayed if it is not completely obstructed. If there is considerable dysphagia, a thread is first introduced, because the thick barium mixture used in making the roentgenogram might completely obstruct the esophagus, which would make it necessary to resort to gastrostomy.

The stricture in the case described was located 33 cm. from the incisor teeth. In about half of the men who have cancer of the esophagus the lesion is located from 27.5 to 35 cm. from the incisor teeth; in women it is at the introitus. At the first visit the stricture was dilated to 45 F. with considerable relief from dysphagia. It is always necessary to measure the length of the obstruction at a second visit, because the lesion has a way of creeping up the esophagus. This patient's stricture happens to be in about the same position as at the first measurement.

In cases of malignant stricture in which there is considerable obstruction, I usually begin with a sound 31 to 32 F. In cases of benign stricture I begin with a much smaller sound,

because usually the density in the wall of the stricture is much greater. No pressure is made until it is evident that the spiral has gone through the stricture. The absolutely diagnostic pink tinged mucus does not happen to be apparent in this case. Another characteristic of malignant stricture, as opposed to benign, is that malignant strictures can be easily dilated to 45 F., whereas the same degree of dilation of benign strictures is not possible without a great deal of trauma. With the second sound, 39 F., there will be bleeding. With the passage of a 45 F. sound the chance of splitting the lesions is relatively slight. The immediate outcome is only rarely fatal.

The comfort derived from the dilation so far outweighs gastrostomy that such an operation is not considered except in the very rare case of complete obstruction. However, if there is any question of a perforation from the esophagus into the trachea, it is unwise to have the patient swallow a thread, because after the thread is swallowed, it will pass into the fistula, be coughed up, reswallowed, and get wound around the trachea. To avoid this the patient must be questioned before he swallows the thread, with regard to the tendency to cough. In such cases it is best to perform gastrostomy, because dilating with safety is out of the question. One must always be careful if there is any coughing after swallowing.

One might conclude from the literature that obstruction of the esophagus from extrinsic masses is relatively frequent. Recently a man came to me with carcinoma of the esophagus who had been told that his obstruction was due to a growth outside the esophagus pressing on it. It is rare for mediastinal tumors outside the esophagus to cause marked dysphagia. Malignancy of the upper esophagus, particularly in women, may be very confusing. Occasionally there may be a primary carcinoma of the thyroid that involves the esophagus, or a primary carcinoma of the esophagus that involves the thyroid, or carcinoma of the thyroid may cause dysphagia by fixing the tissues. The larynx, as you know, has to be elevated in swallowing. If carcinoma of the thyroid fixes the tissues, this becomes impossible.



**Case II. Hysterical dysphagia.**—This woman, fifty years of age, illustrates an interesting type of esophageal trouble, designated hysterical dysphagia. The difficulties are perfectly characteristic. Such patients have a fairly long history of dysphagia, always or almost always limited to solid food. They rarely have any trouble in swallowing soft, finely ground, or liquid food, but particles of solid food will give a marked sense of obstruction. They avoid solid food, such as meats and green vegetables, and consequently develop a marked or moderate secondary anemia, apparently due to dietary deficiency. They rarely lose weight, because they get enough food of a certain kind, but not the proper type for blood building. Sometimes the spleen is considerably enlarged.

The size of the sound passed is not significant, the staff might be passed with equally satisfactory results. Following the passing of a sound the patients are completely relieved, and enjoy normal diet; the blood count becomes normal, and the spleen returns to normal size. The patient may be assured with almost mathematical certainty that anything may be eaten afterward without dysphagia.

One of the characteristic features of this affliction is the patient's inability to swallow pills. Occasionally the onset is sudden. One woman who came to me for treatment had choked on a peanut when she was ten years old. Her mother was obliged to grind her food very fine so she could swallow it.

Many such cases are diagnosed stricture of the introitus. There is a normal narrowing, simulating a cicatricial stricture, which causes slight obstruction to the passing of a sound. The "obstruction" is always located high in the throat. One does not really dilate, the sound is passed merely as a suggestive measure. Patients with this hysterical form of trouble are not usually otherwise neurotic. A certain proportion of them have recurrences, usually when the general resistance is lowered. I had a letter from a woman yesterday who was here two years ago for dilation. For a year and a half she was completely relieved, and could eat anything. Then her child became ill, she worked hard, and worried, and dysphagia recurred. One

patient who could eat anything after one dilation was still unable to swallow pills. She came back to the Clinic and a sound of the same size was passed; she was then able to swallow pills. There was simply need of further suggestion.

In certain of these cases the splenic enlargement is likely to be attributed to something of a more serious nature, when it is really due to a dietary deficiency, because when normal diet is resumed the spleen diminishes in size. Occasionally after passing sounds, a moderate hypothyroidism develops which is evidently due to the atrophy from disuse of the thyroid. When patients begin to take food, they are unable to assimilate it, and therefore develop thyroid deficiency. By giving thyroid extract the hypothyroidism disappears.

The sound is passed on a previously swallowed thread, otherwise there is a real difficulty in passing the introitus. That is why certain physicians have been led astray in the diagnosis and treatment of these cases. Often such patients have false teeth, which may be a factor in the dysphagia. Patients with hysterical obstruction never have any sense of obstruction low in the esophagus, a location which indicates a definite lesion. Occasionally these patients complain of soreness of the tongue, and the tongue may resemble that in cases of pernicious anemia. Yet there is only secondary anemia with a color index of 0.5 to 0.6+.

This patient has had trouble in swallowing for two years. She gradually developed inability to swallow solid food. She is unable to swallow pills or meat, and has eaten no meat for two years. She knows before eating that certain things will not go down. I had one patient who said she could eat all kinds of ice-cream except strawberry because of the seeds. This patient has lost six or seven pounds, and has noticed excess saliva. In such cases there are no peculiar noises on swallowing such as are heard in cases of pharyngo-esophageal diverticulum. The general health of this patient is otherwise perfectly good. Her hemoglobin is 50 per cent; the erythrocytes number 4,160,000, leukocytes 4,700, and the color index is 0.6.

In passing a 41 F. olive, almost without exception a certain

plete closure for twenty-four hours, when the procedure was repeated

Passing sounds will occasionally relieve temporarily, but the only thing that affords any reasonable chance of complete cure is the mechanical stretching of the cardia by the use of the dilator. We use Plummer's modification of the Russell dilator.

About 25 per cent of these patients have recurrence, but it is practically never as bad as the original cardiospasm. Occasionally a patient will have several recurrences. If there is to be a recurrence it almost always comes within six months. We keep a patient around for a week to be sure that the trouble has subsided.

Sometimes it is difficult to tell that the dilator is in place. It may slip into the stomach. We don't attempt to work under the fluoroscope, however, as the difficulties of such a procedure outweigh its advantages. The work must be done in a dark room; the esophagus gets full of mucus, and watching the water gauge, which is essential, becomes difficult in the dark. If the patient is not relieved, at least temporarily, the cardia has not been dilated. Sometimes there is a recurrence because the lesion is secondary to an intra-abdominal condition, but ordinarily any other lesion will not be demonstrated. Certain patients with cardiospasm have had gastric or duodenal ulcers. It is, however, almost impossible to demonstrate the ulcer until the cardia has been dilated, because it is not possible to get enough barium into the stomach to make a satisfactory examination. Secondary cardiospasm is, however, rare, the condition is usually primary.

A sound is passed for three purposes: (1) to be sure there are no knots on the thread, (2) to be sure that the lesion is spasm, and (3) to measure the distance of the cardia from the incisor teeth. Occasionally there is difficulty in passing the sound because of angulation, and without the thread it would not be possible. The distance to the cardia varies in different persons, and one cannot, therefore, be governed by distance in dilating. The dilator is passed just as the sound is passed, and then the water pressure gradually elevated, but not higher than 28 feet. When

real stretching is accomplished, as evidenced by pain, the pressure is held there for just a few moments; it is then relaxed and the dilator withdrawn. The tendency of the dilator is to push downward; if it is advanced too far, it will almost surely go into the stomach. Unless the patient has pain, the cardia has been missed. This patient had pain first, then, as you noticed, a sort of relaxation; that was because the dilator had pushed up into the esophagus. When the dilator is really in the cardia, there is increasing pain until the water pressure is relaxed.

Occasionally patients have attacks of colic following dilation of the cardia. This comes on within twenty-four to thirty-six hours after the dilation, and the patient may double up with pain. Nothing will relieve the colic but a hypodermic of morphin. Of course, dilation of the cardia entails some danger. We have dilated about 450 patients, some of them several times, so that the total dilations would be from 1,200 to 1,500. There have been four deaths, which is not a high mortality. A split at the cardia causes death.

None of the hypotheses with regard to the cause of cardiospasm is satisfactory; that of protein sensitization is perhaps logical, as many of the patients we have seen have also been subject to asthma and hay-fever.

**Case IV.—Cardiospasm.**—This woman, fifty-nine years of age, has had cardiospasm for forty years, with a considerable amount of pain, and trouble in eating. She has been in the habit of carrying a bottle of chloroform to inhale when the pain came on. I dilated the cardia a week ago, and she was relieved from her dysphagia completely, but not from the pain. Often another dilation will relieve the pain and discomfort, and with this hope I am doing this second dilation.

Few of these patients with cardiospasm are ever esophagoscoped, because there is nothing to see. The esophagus is filled with food and mucus, and the procedure, besides being unsatisfactory, is disagreeable to both physician and patient. Occasionally a person with cardiospasm will have a sensation

of food sticking in the upper esophagus, but more often the sensation of obstruction is at the cardia.

Carcinoma of the cardia has to be differentiated from cardiospasm, also from diverticula at the cardia, congenital or acquired hernia of the stomach through the diaphragm, diverticula of the stomach near the cardia, angina, and gallbladder disease. In certain cases the colic may antedate dysphagia by several years. I had one patient, a girl, who had had attacks of colic for fourteen years before dysphagia began.

This is the first time I have ever had a bag rupture, but it illustrates why water and not air is used for pressure. Air would balloon the patient before one realized that anything had happened. With water the drop in pressure is seen at once on the meter. The water is shut off immediately, and everything is all right. Probably the reason this bag ruptured was because a nurse, new on our service, boiled it the other day. I put on a new outside rubber bag, but evidently the inner one had been weakened, too. These bags will not stand boiling, they must be kept sterile by careful washing, and then by standing in alcohol. In this way they will last for months. We make our own dilators. They are simple in construction: first, there is an outer rubber bag, then a heavy silk bag, and inside of this another rubber bag; then a 28 F. stomach tube with multiple perforations.

If patients who are having dilations are here with relatives and are not having any discomfort after the dilation, we allow them to go back to the boarding house if they desire. If they are here alone, or are having pain, they are sent to a hospital. Of course, if the esophagus or cardia splits, the last card has been played. Some of the patients develop pleurisy with effusion. We let patients eat as soon as they want to, and whatever they want. No complications result.

**Case V.—Foreign body (corn) in the bronchus.**—This little girl, about five years old, had been helping to feed the horses a week ago, and ran into the house coughing, and told her mother she had swallowed a kernel of corn. She coughed for

about twenty minutes, and ever since has had paroxysms of coughing, particularly at night. She has had constant wheezing, even between the paroxysms of coughing. There was no noticeable fever, although the mother thinks that two days ago there was a little in the afternoon. The child at present is in good condition, and there are evidences of a foreign body in the left bronchus. There is a definite suppression of breath sounds over the lower lobe of the left lung, and I thought it unnecessary to have an x-ray examination of the chest because the history is characteristic enough to warrant a definite diagnosis of foreign body. The body is large enough so that it sometimes becomes loosened from its impaction in one or the other of the bronchi, and because of its movements in the trachea it gives rise to the paroxysms of coughing.

The difficulties with a case of this type are the danger of having the foreign body coughed into the larynx, producing laryngeal obstruction, and the danger of the foreign body, such as a grain of corn, becoming impacted in the trachea, obstructing respiration. It is always advisable to have everything ready for a tracheotomy in cases of this type when performing a bronchoscopy. For children we use general anesthesia, because, in the hands of the average operator, the case can be more safely handled. It is realized that in doing this there is a chance of the laryngeal obstruction occurring before the bronchoscopy has begun.

I want to use this larger bronchoscope if possible, because it is hard to work with the smaller one, the field is so limited. I can't get it in, so I will have to use the smaller 'scope, which is always a handicap. One is not justified in using much pressure in passing the tube in these cases. The vision is so tremendously improved by the larger 'scope that we use it whenever possible. The 'scope is dropped down back of the epiglottis, pulled forward, turned at right angles, and then slid in through the larynx. We use Bruening's bronchoscope. The size of the larynx varies considerably in different children. Ordinarily the larger 'scope may be used without undue trauma.

The kernel of corn is free in the trachea. Before the forceps

could be introduced, the corn had been sucked tightly into the left main bronchus. It is so tightly impacted and soft from the prolonged sojourn that every time I apply the forceps a portion of it breaks off. I do not like to keep children under anesthesia very long, but it seems better than to stop and try again later, under the same or worse conditions. I cannot grasp the whole kernel, and shall have to break it up as much as possible and take it out in pieces. This way of removing vegetable foreign bodies is, of course, unfortunate, but at times such foreign particles as beans and corn or grain become so softened in the secretions from the bronchial mucous membrane that such a procedure is unavoidable. It is, of course, far better to remove the foreign body in one piece. In cases of foreign bodies, particularly those of vegetable origin, it is sometimes necessary to perform a tracheotomy during the first twenty-four hours after removal.<sup>1</sup> This should be done if the patient shows any evidence of dyspnea, and should not be postponed until he is in extremis.

**Case VI.—Cicatricial stricture.**—This child was brought to the Clinic August 25; she was then eighteen months old. Five weeks before she had accidentally swallowed a small amount of concentrated lye. She burned her mouth and face rather severely, and vinegar was administered as an antidote. She was also given sweet oil. After the first week, during which time she took only liquids on account of the soreness of the mouth, she was apparently recovering and was able to eat, but after the third week she began to have trouble in swallowing solid food, which she regurgitated.

At the time of admission she was able to take liquids fairly well. We had trouble in getting a thread down because her teeth were so sharp that she kept biting it off unintentionally. We finally passed it through her nose. At the first dilation the stricture was stretched to 25 F. The obstruction was at the introitus. She has had five dilations, the last one November 5,

<sup>1</sup> This child had to have a tracheotomy the same night, but had an uneventful convalescence.

when a 37 F. was passed, using a moderate amount of pressure. In these cases the stricture usually dilates fairly readily, and the size of the sound is gradually increased until the stricture is dilated up to 45 F. According to the amount of difficulty which the patient has in swallowing, the size of the sound is increased, and the period between the stretchings prolonged as much as possible. No anesthesia is used in dilating, and there is relatively little discomfort in passing the sound. I am now passing a 40 F. sound without difficulty, and with only a slight amount of bleeding. As it has been almost three weeks since her last dilation, we will allow her to wait about a month before she has another treatment. There is no advantage in dilating these strictures every week because the trauma delays healing and really accomplishes very little. In most of these cases the strictures can be dilated up to 45 F. in two or three stretchings, but such a procedure would cause too much trauma.

These patients do not have breakfast, because if they have eaten, dilation is more likely to be followed by vomiting and coughing. It is advisable to pass a sound every six months for three or four years, even though there may be no dysphagia. Occasionally after dilation there will be a certain amount of reaction, with elevation of temperature, but this does not last long. After these strictures are once dilated up to 35 F., almost any amount of pressure may be used with safety, but it is not necessary. After the first dilation children can begin to swallow the thread before they leave home, and then they are ready for the dilation when they get here.

**Case VII.—Cicatricial stricture.**—We commonly associate strictures, following ingestion of caustic substances, with children, but adults are also subject to such accidents. This man is fifty-one years of age. Five months before admission, he was taking some medicine in the dark, and accidentally took a dose of a preparation that his wife had been using externally for goiter, which he believes contained ammonia. It burned the esophagus. He was unable to swallow anything for three days, then began to take fluids. He has had complete closure for three or four days



at a time His weight dropped from 156 to 122.5 pounds Attempts were made elsewhere to pass sounds through the stricture, but without success

He swallowed the thread without difficulty, and on the day after his arrival we dilated the stricture to 28 F. The stricture is 31 cm. from the incisor teeth. Cicatricial stricture, in contradistinction to malignant, may be anywhere along the esophagus. They are usually single, but may be multiple. The thread is of distinct advantage in cases of multiple strictures. Working through the esophagoscope is possible in cases of single stricture, but is not safe in multiple strictures This patient has had four dilations He is eating everything, and weighs 142 pounds, a gain of 20 pounds in a month. It has been ten days since the last dilation The stricture is very dense and it is better to hold it at a 34 or 35 F. than to use too much pressure in stretching He may now wait two weeks before the next stretching unless he begins to have trouble in swallowing.

There is no reason for using the esophagoscope unless it is suspected that a foreign body is located above the stricture. To work through the esophagoscope simply adds a certain amount of discomfort. The safest way is to pass the sounds on the thread from above downward The retrograde dilation, necessitating gastrostomy, entails more risk from the operation than any of the stretchings done in this manner.

**Case VIII.—Pharyngo-esophageal diverticulum.**—This man is seventy-five years of age He did not notice this trouble until a year ago, following a pharyngitis, when food lodged in his throat. Previously he had swallowed without trouble. Now he has a sore feeling in his throat when he eats, and a tendency to cough. During coughing spells food taken the meal before is regurgitated If he wants to take a pill he has to take some kind of food first; otherwise the pill seems to lodge in a sac. A roentgenogram taken by his home physician revealed a diverticulum He is troubled chiefly by a large amount of mucus when he lies down at night. His general health is good except for possible anginal attacks Roentgenograms taken

here show a small sacculation, but a diagnosis of diverticulum cannot be accepted on roentgenologic evidence alone. - A stricture high in the esophagus might produce a like shadow. The only sure way is to have a patient swallow a thread and then pass a sound, allowing the thread to become perfectly lax. The sound will always drop into the sac because it comes off posteriorly. By drawing the thread taut the sound is pulled up to the opening of the esophagus; it then slips down without obstruction.

One of the symptoms, of which patients sometimes complain, is a gurgling noise in the throat when they are swallowing. If, after a patient with diverticulum has swallowed water, pressure is made on his neck, the water will be forced up into the mouth. This is the nineteenth pharyngo-esophageal diverticulum that I have seen in the last eleven months. All have been in men. This is one of the points in the differential diagnosis. In cases of hysterical dysphagia there is also a sense of obstruction high in the throat, but the patients are almost all women, whereas almost all patients with diverticula are men. Diverticula of the middle third and cardia are rather infrequent.

Ordinarily these patients should be operated on. The two-stage operation, as performed by Judd and C. H. Mayo, is the method of choice if the patients are in good condition. Unfortunately many of these patients are very old. Such diverticula do not develop in early life, but almost always after the age of thirty-five. Old patients are rather a bad risk simply because of their age. The advisability of operation depends on the amount of trouble they are having. This patient, seventy-five years old, with a history of probable angina, will probably not be operated on. Most of the sacs increase in size, some becoming very large. As they enlarge their weight so constricts the esophageal opening that complete closure may result. Occasionally a patient will have a completely obstructed esophagus, and except for the dehydration and starvation is a good surgical risk. I have such patients swallow a thread, and, with this as a guide, pass a stomach tube to feed them. The tube could not possibly be passed without the thread. The patient or some

relative can be trained to pass the tube on the thread, and thus the patient is built up for operation. One patient observed recently, a man fifty-six years old, had probably had a diverticulum for three years. The sac was very large and the esophagus was almost completely obstructed. He was fed by means of the tube for about a week, then he was taught how to pass it himself, and he went home. He gained weight from 119 to 145 pounds in five weeks. Then he came back and had his operation without trouble. He reported about four or five months after this operation that he weighed 175 pounds, and was eating everything without difficulty. When he first came he was so weak that any operation would have been fatal. The opening of the esophagus can be found with the esophagoscope, but it is not practicable to use it four or five times a day for feeding.

The older the patient, the more difficulty he has with the thread. He gets the idea that he cannot swallow it. This patient came in and said he couldn't get it down. I asked him how long he had tried, and he said two minutes. I told him to try for twenty-four hours, and he came back today with it in.

## SURGERY OF THE STOMACH

JOHN H. LYONS AND E. STARR JUDD

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**Case I.**—This five-months-old baby was brought to the Clinic September 26, 1923, because of vomiting. She had vomited small amounts occasionally since birth, but for five weeks projectile vomiting had occurred after practically every meal. For three days before coming to the Clinic she had been in a semicomatose condition.

On examination peristaltic waves could be seen in the left upper quadrant. A diagnosis of hypertrophic pyloric stenosis was made. The baby was so dehydrated that it was decided to try to restore her body fluids before operating; she was given a transfusion, and sodium chloride solution intraperitoneally and subcutaneously; fluids by rectum were not retained.

The abdomen was explored through a short high right rectus incision. The pylorus was found to be completely occluded by the hypertrophied pyloric sphincter. A Rammstedt operation was performed; that is, a longitudinal incision was made in the pylorus, cutting all the fibers of the hypertrophied sphincter. The incision extended down to the mucosa, which allowed the pylorus to open widely. It was necessary to tie several vessels in the cut edge of the wall of the stomach. Under the direction of the Department on Pediatrics in the Clinic feedings were started the day of operation, and the baby has improved greatly.

The most dangerous complication in such cases is hemorrhage from the wound. Infants have so little blood that a small hemorrhage may prove fatal. It is, therefore, advisable to apply a very small dressing and have it watched carefully.

This case is entirely typical of congenital pyloric stenosis. The baby was brought to the Clinic as badly emaciated and dehydrated as it is possible to be and yet live, and she was really

in a *semicomatose* condition. After the body fluids had been restored by one or two transfusions, the operation was performed. While in some instances it is undoubtedly advisable to try palliative measures, I think they would have been fatal in this one. Measures of this kind had been carried out fairly well before the baby was brought to us, but at this time an operation was very definitely indicated. In our experience certain patients with similar symptoms, though not in so extreme a condition, have responded to treatment. In a few instances the results of treatment have only been temporary, and it was necessary to resort to operation later. Others have apparently remained well. We consider the Ramstedt operation the operation of choice in such cases, and very rarely is a gastroenterostomy indicated.

**Case II.**—This boy, fourteen years of age, came to the Clinic July 16, 1923, because of abdominal pain. He had never been strong and rugged, and his appetite had always been poor. For two years he had been having pain in the region of the umbilicus, radiating to both sides of the abdomen. The pain apparently bore no relation to eating, but came on almost every day and sometimes at night. Occasionally vomiting would occur at the same time. Soda afforded no relief. For two weeks the bowel movements had been tarry. The patient had lost 23 pounds. x-Ray of the stomach revealed a lesion of the pylorus. He went home for three months, but returned with symptoms possibly worse than before.

Exploration, October 17, revealed a chronic penetrating type of gastric ulcer, which was excised. Also posterior gastroenterostomy and appendectomy were performed, the appendix being slightly inflamed. The first four days the patient was given nothing by mouth, but received 1,500 c. c. of fluid by proctoclysis each day, sodium chloride solution and glucose being given on alternate days. He recovered uneventfully.

The average age of patients with gastric ulcer is thirty-five years, the condition rarely occurs in a patient the age of this boy. I believe he is the youngest person we have ever seen

with gastric ulcer. We have had an opportunity to observe a few children with ulcer of the duodenum, and a considerable number with gallstones, but we have rarely seen cases of ulcer of the stomach in young people. Although but fourteen years of age when he was operated on, he had had a very definite stomach complaint for at least two years. The lesion was practically identical with the gastric ulcer in the adult. It had a definite crater, and there was considerable local peritonitis. Because of his youth we thought at first we should try to accomplish something medically, so he was treated for a time, and finally went home to continue the régime. In some respects the treatment seemed to help him, but in others it did not, so we decided to institute surgical measures. In gastric ulcer cases radical resection is performed, excising the ulcer and also performing gastro-enterostomy, as either procedure alone results in a high percentage of failures.

**Case III.**—This man, twenty-six years of age, came to the Clinic October 21, 1923, because of epigastric pain two hours after eating, which he had been having in spells for three years. He was relieved by food and soda. He had had a severe gastric hemorrhage in August, 1921, and another in July, 1923.

The hemoglobin was 70 per cent. A test meal revealed total acidity 56, and free hydrochloric acid 44. Duodenal ulcer was demonstrated by the x-ray.

Exploration revealed an ulcer on the anterior surface of the duodenum, beginning just below the pylorus and involving the cap of the duodenum. The ulcer was excised by two elliptical incisions perpendicular to the long axis of the duodenum, and the opening closed so that the suture line was still perpendicular to the long axis of the duodenum. The pylorus was wide open, and therefore it was not necessary to do anything to it. The patient has recovered uneventfully.

In suitable cases of duodenal ulcer we prefer to excise the lesion and, if necessary, to perform pyloroplasty at the same time. If the ulcer has been of the bleeding type excision is particularly indicated, for about 13 per cent of our patients

with bleeding ulcer, for whom a gastro-enterostomy has been performed, continue to have some bleeding at intervals. However, in a very large percentage of the operable cases of duodenal ulcer, it is inadvisable to attempt excision because of the amount of operating required to mobilize the duodenum sufficiently accurately to carry out the technic. It should be constantly kept in mind that gastro-enterostomy has been an extremely satisfactory operation in cases of duodenal ulcer, and we are not justified in attempting anything more hazardous, but if the duodenum is easily mobilized and the ulcer is situated on the anterior surface, it is frequently easier to excise it than to perform gastro-enterostomy; and excision has its advantages, especially when the ulcer is of the bleeding type. In case the pyloric opening is too narrow, it can be enlarged by cutting the fibers of the sphincter. The form of the duodenum is changed less by excising an ulcer in this way than by any other method.

**Case IV.**—This woman, fifty-three years of age, came to the Clinic November 2, 1923, because of epigastric pain and vomiting, from which she had suffered for about a year. The pain was usually relieved by food and vomiting, but at times was so severe as to require morphin. The patient lost 20 pounds. A test meal revealed total acidity 38 and free hydrochloric acid 28. Duodenal ulcer was shown by the x-ray.

At exploration a large, chronic, penetrating ulcer of the duodenum was seen on the anterior wall, 2 cm. below the pylorus. There was a great deal of local peritonitis. The gallbladder was normal. The ileocecal coil was adherent; the appendix, therefore, was not explored. A posterior gastro-enterostomy was performed, and the patient has had an uneventful convalescence.

In this case excision of the ulcer was not to be considered, because of the local peritonitis. Excision can be made in a limited percentage of cases only, the duodenum must be freely movable, so that the ulcer can be brought up easily; the duodenum must not be markedly deformed; there must not be extensive local peritonitis. However, gastro-enterostomy for duodenal ulcer is very satisfactory; the operative mortality is low and the

percentage of cures high. In cases of duodenal ulcer the appendix is examined, and if not normal, it is removed unless it is adherent and would add considerable risk to the operation.

**Case V.**—This woman, forty-three years of age, came to the Clinic November 6, 1923, because of attacks of pain in the epigastrium which she had had since she was fifteen. These usually occurred in the fall and spring. The pain came on two or three hours after meals, and was relieved by food. A test meal revealed a total acidity of 60, and free hydrochloric acid 40. x-Ray of the stomach revealed gastric ulcer.

At exploration multiple gastric ulcers and a duodenal ulcer were found. The duodenal ulcer and one gastric ulcer had large craters. It was decided that the only hope for complete relief was to remove the portion of the stomach and duodenum which included these ulcerations. Gastro-enterostomy in such a case could hardly be expected to give complete relief, and excising the ulcers and performing gastro-enterostomy would have required more operating than simple excision of the ulcerated portion of the stomach and duodenum. The cut end of the duodenum was turned in, in the usual way, and the proximal end of the stomach was anastomosed to the side of the jejunum just a few centimeters beyond the ligament of Treitz. The whole anastomosis was made through an opening in the transverse mesocolon according to the Polya plan. The patient has recovered uneventfully.

In performing a posterior Polya operation as much stomach as necessary is removed, and the duodenal stump is turned in with one row of catgut and one of silk. A loop of jejunum is then brought up through the transverse mesocolon and anastomosed to the cut end of the stomach. The anastomosis is dropped back through the opening in the mesocolon and the edges of the opening in the mesocolon sutured to the stomach about 1 cm. above the line of anastomosis.

Patients who have had such operations are given fluids by rectum until the sixth day, when they are given liquids by mouth, and the diet is gradually increased until by the tenth day they



are getting a rather liberal diet. If the patients are dehydrated, however, liquids by mouth are given earlier.

**Case VI.**—This man, aged fifty-seven years, came to the Clinic September 21, 1923, because of loss of appetite for about a month. He vomited coffee ground material once, about ten days before coming to the Clinic. He had lost 10 pounds.

At examination a large mass could be felt in the epigastrium. A test meal revealed achlorhydria, and the x-ray, carcinoma of the stomach with obstruction, which was operable from a roentgenologic point of view. The patient's hemoglobin was 32 per cent. His stomach was irrigated twice a day, and he was given a transfusion which raised the hemoglobin to 58 per cent. The stomach is lavaged before operation, only if there is obstruction.

Exploration revealed extensive cancer of the stomach. The lymph glands were also extensively involved, but it was possible to explore beyond them, no other demonstrable metastasis was found, however, so a posterior Polya operation was performed. About four-fifths of the stomach was removed. The patient developed bilateral bronchopneumonia with pleurisy, which prolonged his convalescence considerably, but he is now improving steadily.

In cases of this type the most common sites of distant metastasis are the liver and pelvic peritoneum. The operative risk in this case was high because of the patient's anemia. Severe secondary anemia in a patient with gastric cancer, who does not have a history of bleeding, usually indicates that the growth is inoperable.

## PERFORATING DUODENAL ULCER

VERNE C. HUNT

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THIS man, thirty-five years of age, has had pain referable to the right upper quadrant of the abdomen for eighteen months. It occurred intermittently in spells of several weeks, from two to three hours after meals, and at night between 12 and 2. Food afforded complete relief. Two weeks ago the patient had an attack of severe sudden generalized upper abdominal pain and general abdominal rigidity, requiring morphin for relief. Ice-bags were applied to the abdomen, and the acute symptoms subsided in five days, but now, two weeks after the onset of the acute attack, rigidity and marked tenderness in the upper abdomen still persist. One hour after an Ewald test meal the total acids are 48, and free hydrochloric 32. The x-ray diagnosis is duodenal ulcer. The recent acute attack very strongly suggests perforation, and the persisting rigidity and tenderness justify the diagnosis of subacute protective perforating duodenal ulcer. Exploration seems advisable.

On opening the abdomen a moderate amount of clear fluid is seen in the peritoneal cavity, apparently non-infective. The lesser curvature and pyloric end of the stomach are densely and subacutely adherent to the inferior surface of the liver and anterior abdominal wall. These structures have sealed over the perforation of the ulcer and have prevented contamination of the general peritoneal cavity.

Perforation of gastric or duodenal ulcers has been considered a fatal complication. However, this is not necessarily or usually true, for the surrounding liver, gallbladder, colon, anterior abdominal wall, and omentum all combine to seal over the perforation, or at least to localize the infection, so that a protective perforation occurs more frequently than a true "blow-out."

Considerable difference of opinion exists regarding the advisability of performing gastro-enterostomy besides closing the perforation in cases of unprotective perforation of gastric or duodenal ulcers. It seems to me that the question of the mortality rate in such cases is dependent chiefly on the time interval between perforation and operation, the amount of contamination, and the degree of peritonitis at the time of operation, rather than on whether simple closure of the ulcer is made with or without gastro-enterostomy. Simple closure of a perforated duodenal ulcer usually does not leave the duodenum very patent, and, likewise, satisfactory closure of a gastric ulcer often disturbs gastric motility, and inadequate drainage is afforded the stomach. Certainly the results of closure of the perforation with gastro-enterostomy are better than with simple closure. If a patient will recover following simple suture of the perforation, in the presence of a given amount of contamination or peritonitis, the addition of gastro-enterostomy, which requires but fifteen or twenty minutes more, will not jeopardize the chances of recovery, but rather enhance them through adequate drainage of the stomach and avoidance of undue tension on the suture line of the perforation. The amount of contamination and the degree of peritonitis will usually determine the chances of recovery. Operation within ten to twelve hours of the perforation, during the stage of contamination, before true peritonitis is established, results in a high percentage of recoveries. However, after this interval, when progressive peritonitis exists, the mortality rate increases rapidly.

In this case there is a protective perforation, the inferior surface of the liver and omentum combining to seal the perforation, and it cannot be improved on by exposing and suturing the ulcer. Gastro-enterostomy is clearly indicated. The first loop of the jejunum readily comes into view by drawing to the right on the transverse mesocolon. I prefer to use a loop of jejunum about three inches long, allowing it to run in the direction it takes naturally, which, in about 90 per cent of the cases, is to the left. The most dependent portion of the posterior wall of the stomach is chosen. Suture of the transverse

mesocolon to the stomach is more readily accomplished before making the anastomosis. Three rows of sutures are placed all the way around; they possess the advantage of complete hemo-

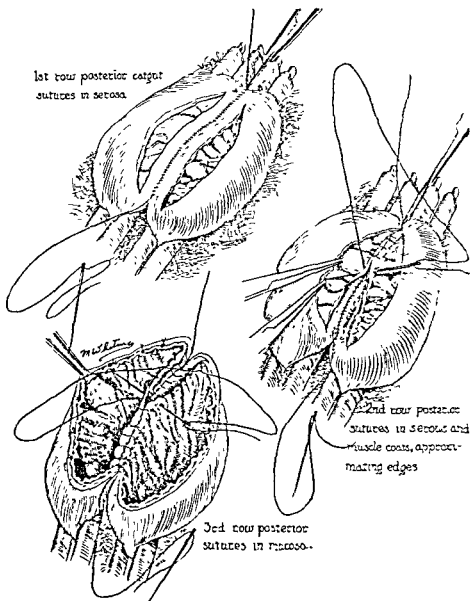


Fig. 91.—Posterior suture line of posterior gastro-enterostomy.

stasis and accurate anatomic approximation. The first row approximates the serous coat of the jejunum and stomach; the second row approximates the serous and muscle coats, and the



## VARIOUS TYPES OF GASTRIC RESECTION<sup>1</sup>

DONALD C. BALFOUR

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THE purpose in presenting these patients to the staff this evening is to show the immediate results following various types of gastric resection for various lesions, to emphasize the fact that no particular method of resection is always the best, and to point out some of the more important points in the technic of the operative procedures.

The first patient, Mrs. E. P., aged sixty-three years, registered in the Clinic December 21, 1923. She had had gastric distress for one year, but it had not been severe, came irregularly, apparently had no relation to time or to the kind of food taken, and there was no nausea or vomiting. Under treatment by her home physician this distress disappeared, but returned in more severe form in August, 1923, being constant, localized in the epigastrium, and keeping her awake at night. In October x-ray examination elsewhere had revealed cancer of the stomach. The hemoglobin at that time was 48 per cent. The patient had lost 30 pounds. Operation was advised against. Transfusion had been performed and the patient placed on a bland diet, which was followed by temporary improvement. She soon began, however, to lose weight again, symptoms of pyloric stenosis developed, blood appeared in the stools, and the anemia and weakness steadily progressed.

On examination at the Clinic a clinical diagnosis of cancer of the stomach was made, a movable tumor being demonstrable low in the epigastrium. The report on the x-ray examination was "operable cancer of the stomach" (Fig. 93). The heart was enlarged from chronic rheumatic endocarditis, but Dr. Willius did not consider this a contraindication to surgery.

<sup>1</sup> Demonstration of patients at the regular weekly meeting of the staff of the Mayo Clinic and Mayo Foundation, January 23, 1924.

Under ethylene anesthesia the pyloric end of the stomach was resected for a cancer of the posterior wall, 5 by 5 by 7 cm, the gastro-intestinal continuity being restored by the Billroth 2 method. The pathologist reported cancer, with moderate glandular involvement. The operation occupied one hour. The postoperative convalescence was uneventful.

One point of particular interest in connection with this patient is that she had been told four months before coming to



Fig. 93 —(Case I) Cancer of the stomach

the Clinic that the condition was inoperable. Although her age, marked anemia, cardiac condition, and extreme weakness might justifiably lead to such a conclusion, yet the growth itself was apparently operable, and there was no recognizable metastasis. If one should attempt to formulate a rule in cases of cancer of the stomach, it would be that in the absence of definite evidence of metastasis, and when the fluoroscopic report leaves doubt as to the operability of the lesion, the patient should be given the benefit of the doubt and exploration advised.

Adhering to such a rule, however, makes low operative mortality rates in gastric cancer difficult to attain, but the Golden Rule is the only right basis on which to advise these patients. The Billroth 2 operation was chosen in this case because the resection was not to be extensive, and the remaining portion of the stomach was sufficiently large easily to permit posterior gastro-enterostomy after the end of the stomach had been closed (Fig. 94)

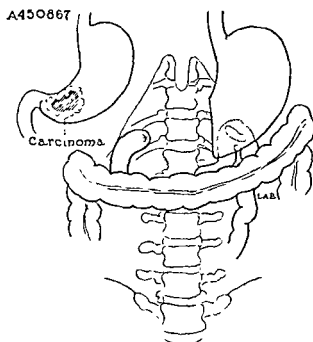


Fig. 94.—(Case 1) Billroth 2 operation.

The second patient, Mrs. T. B., aged forty-three years, registered in the Clinic January 5, 1924. For about thirteen years she had had periods of vomiting about once a year, and lasting several days. In 1919 she vomited daily for weeks, and was finally relieved by gastric lavage, a method of relief which has been used since that time. The last spell was in November, 1923. A great deal of weight had been lost. The pain had been unusually severe for ulcer, but was not regular in type.

On examination at the Clinic a clinical diagnosis was made of gastric ulcer. The gastric analysis revealed total acidity 48,



and free hydrochloric acid 30. The x-ray report was of a perforating gastric ulcer in the body of the stomach with hour-glass contraction (Fig 95). The hemoglobin was 50 per cent.

Operation was performed under ethylene anesthesia and a perforating ulcer found on the posterior wall of the stomach, adherent to the pancreas, the crater being about 3 cm. in diameter. A sleeve resection was performed and the operation completed in thirty minutes. The pathologist reported simple



Fig. 95 —(Case II) Perforating gastric ulcer and hour-glass constriction

perforating gastric ulcer. The convalescence was uneventful, the patient was out of bed on the eighth day after operation, left the hospital on the thirteenth day, and will return home on the nineteenth day.

This case illustrates the fact that sleeve resection is occasionally a very useful operation. In cases of high-lying lesions associated with hour-glass contraction, particularly if the ulcer is posterior and adherent to the pancreas, resection of the entire pathologic process can be safely accomplished by this

method with the sacrifice of only a minimal amount of healthy gastric tissue. Since these posterior perforations are usually highly inflammatory, the utmost care should be taken to avoid soiling in separating the lesion from the pancreas. In this case the segment of stomach was first completely mobilized, leaving the point of attachment of the stomach to the pancreas to be divided last by the cautery (Fig. 96).

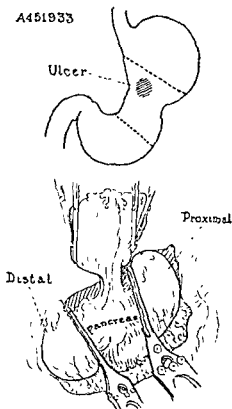


Fig. 96.—(Case II.) Sleeve resection for gastric ulcer.

The third patient, Mrs. C. B. L., aged forty-seven years, registered January 7, 1924. She had had irregular and indefinite digestive disturbance for many years which was relieved by dieting. For the last two years these spells of epigastric distress with bloating had become more frequent and of longer duration. Solid foods were gradually given up. The pain was relieved by vomiting or soda, but during the last six weeks the patient had not been able to empty her stomach, so that the pain in-

creased. It was of a gripping, drawing character, radiating around both costal margins, through to the back, and beneath the left shoulder blade.

Gastric analysis revealed total acidity 70 per cent, and free hydrochloric acid 54. A clinical diagnosis of perforating ulcer was made, and confirmed by x-ray (Fig. 97).

Operation was carried out under ethylene anesthesia and a large perforating gastric ulcer of the posterior wall, about 10



Fig. 97 —(Case III) Perforating gastric ulcer

cm from the cardia, was found. There was also a chronic ulcer of the anterior wall of the duodenum. Continuity was re-established after resection by posterior end-to-side anastomosis. The patient had an uneventful convalescence, was out of bed on the eighth day, left the hospital yesterday (the thirteenth day), and will leave for home in four or five days.

Resection was considered advisable in this case because the size of the lesion made malignant degeneration of the ulcer a strong possibility, and because the end-results of less radical

treatment of large posterior ulcers are not always satisfactory. The posterior Polya operation, with the proximal jejunum approximated to the lesser curvature, is an excellent method when enough stomach remains after resection to permit the anastomosis to be drawn down below the opening in the mesocolon and to hang to the left of the middle line (Fig. 98). It is most important in such cases that the proximal loop of jejunum be of sufficient length to permit free functioning of the anastomosis,

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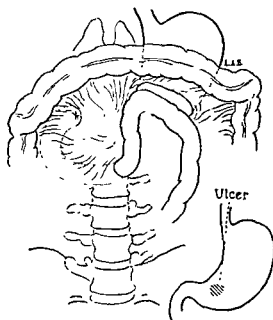


Fig. 98.—(Case III ) Posterior Polya operation.

thus avoiding the mechanical complications which may be caused by too short a proximal loop

The fourth patient, Mr. J. H. G., aged forty-three years, registered December 31, 1923. He had visited the Clinic two years before, because of stomach trouble of six or seven years' duration. The chief symptom was pain of a pressing character, usually after meals, and relieved by vomiting and belching. He had not lost blood. The gastric analysis revealed total acidity 40 and free hydrochloric acid 20. Although ulcer was suspected,

the x-ray did not give evidence of it. The patient was advised to go home and return if symptoms persisted. When he registered last month his symptoms were the same, but more severe. Although he had been fairly well for a year after his first visit to the Clinic, the attacks had recurred, and for the last two months the pain had been almost constant. The attacks began with a dull cramp in the abdomen, followed by vomiting, and on two occasions a small amount of blood had been vomited. Blood had also been found recently in the stools.



Fig 99 —(Case IV) Perforating gastric ulcer on the lesser curvature.

The gastric analysis revealed total acidity 58, and free hydrochloric acid 36. The x-ray, on this occasion, revealed a perforated gastric ulcer on the lesser curvature, which was adherent to the pancreas (Fig 99).

A partial gastrectomy was performed under ether anesthesia, continuity being restored by antecolic end-to-side anastomosis, combined with entero-anastomosis (Fig. 100). The appendix was also removed, and the operation completed in one hour.

and twenty-five minutes. The pathologist reported "Simple gastric ulcer 2.5 cm. in diameter with inflammatory glands. A section of the pancreas to which the ulcer was adherent did not reveal evidence of malignancy." The patient recovered uneventfully and left the hospital on the thirteenth day; he will return home on the nineteenth or twentieth day.

The resection was also indicated in this case because of the unsatisfactory permanent results usually following less radical

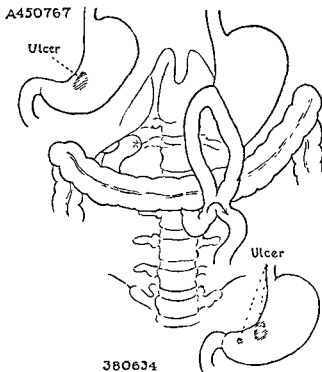


Fig 100.—(Cases IV and V.) Antecolic end-to-side anastomosis, combined with entero-anastomosis.

procedures for posterior perforated ulcer adherent to the pancreas. An antecolic end-to-side anastomosis was performed, chiefly for two reasons: (1) the resection was too extensive to permit an easy posterior anastomosis, and (2) the mesocolon had become involved in the inflammatory process which had spread through the lesser peritoneal cavity. Anterior anastomosis avoids this area of inflammatory adhesions. I believe that fewer postoperative complications and better end-results will

follow if an entero-anastomosis is also performed in similar cases. Retrograde distention of the duodenal segment, with the possible complications which may ensue from it, is practically prevented by entero-anastomosis.

The fifth patient, Mr. A. L. R., aged sixty-five years, registered December 19, 1923. Ever since his youth he had had periodic attacks of epigastric distress and pain, and had always been constipated. Ten years before coming to the Clinic he had had



Fig 101—(Case V) Large perforated ulcer in the body of the stomach.

a very severe attack, and since then had occasional spells lasting two or three weeks. One year after this acute attack, appendectomy had been performed, but without relief. For a year the distress has been more or less continuous, with tarry stools, and he had lost twenty pounds during the last two months.

A clinical diagnosis of gastric ulcer was made and the x-ray revealed a large perforated ulcer in the body of the stomach (Fig. 101).

At operation under local and ether anesthesia (time, one

hour and twenty-five minutes) an anterior end-to-side anastomosis with entero-anastomosis type of resection, was performed (Fig. 100). The pathologist reported a subacute perforating ulcer 3 cm. in diameter and 1.5 cm. in depth, and inflammatory glands.

The operation in this case was similar to that in Case IV. After the stomach had been separated from the pancreas, the large base of the ulcer still remained on the pancreas. This was



Fig. 102.—(Case VI.) Cap deformity of the duodenum, and gastro-enterostomy, free and low, on the stomach

excised with the cautery, the area covered as carefully as possible, and a rubber tissue drain carried to this point. Drainage along the tract established by the drain continued for several days, and the patient did not leave the hospital until the twenty-fourth day.

The sixth patient, Mr. H. F., aged thirty-two years, came to the Clinic December 14, 1923 because of epigastric pain of five years' duration. The attacks had occurred two or three hours



after meals, with vomiting, and were relieved by food and soda. Two years before, gastro-enterostomy had been performed elsewhere for duodenal ulcer. The patient improved, but a few months before, the symptoms had returned and he had lost a large amount of blood by vomiting and tarry stools.

The hemoglobin was 67 per cent, total acidity of gastric contents 60, and free hydrochloric acid 40. A clinical diagnosis

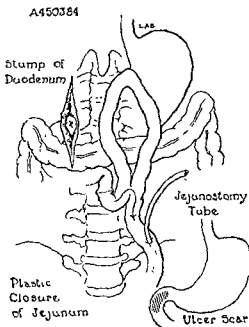


Fig. 103 —(Case VI) Operative procedure for duodenal ulcer of the anterior wall.

of bleeding duodenal ulcer was made. The x-ray revealed a cap deformity of the duodenum, and the gastro-enterostomy, free and low, on the stomach (Fig. 102).

Operation was performed under ethylene anesthesia, and a large duodenal ulcer of the anterior wall was found (Fig. 103).

The operation in this case was prolonged (one hour and fifty minutes) and difficult, but it was necessary in order to insure the patient against further hemorrhages. The gastro-enteros-

tomy was first disconnected, the large ragged opening in the jejunum closed, and the stomach resected to a point well above the opening of the gastro-enterostomy. The closure of the duodenum was difficult because of extensive scarring of the ulcerative process. As much of the duodenum was resected as was safe, the stump was closed, and, because of the doubt of the security of this, the stump was covered by omentum and suspended by a suture to the parietal peritoneum at the upper point of the incision. The value of this was seen during the patient's convalescence, when on the tenth day drainage of duodenal contents was noted through the incision, which gradually lessened until it had completely healed, several days before the patient left the hospital. The antecolic end-to-side anastomosis with an entero-anastomosis was performed, the latter step in such a case being particularly indicated because of the extensive plastic operation necessary to close the opening in the proximal jejunum. A further procedure of safety was the catheter jejunostomy through which feeding was carried on for one week following operation



## A CONSIDERATION OF SOME OF THE FUNCTIONS OF THE LIVER

FRANK C. MANN

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THE liver should be considered by the surgeon as an organ of great surgical significance, for while it has not thus far proved amenable to surgical procedure, it occupies an anatomic and physiologic position of great surgical importance. It is in intimate association with structures such as the biliary tract, the stomach, and the duodenum, in which modern surgery has attained some of its greatest triumphs in the cure and amelioration of disease. The liver is probably of more importance, however, from the physiologic standpoint; it is so closely involved in so many physiologic processes, that it must be a factor of importance in practically every operation. It is possible that many of the factors which make for or against a good surgical risk depend on the functional condition of this organ.

Many difficulties have delayed the development of knowledge concerning the function of the liver; for example, its distinctive and peculiar anatomic position, and its complex physiologic relationships. Because definite data concerning the function of this large and unique organ have been so difficult to obtain, many findings and observations which could not be demonstrated as functions of any particular organ or tissue, have been ascribed to it, and consequently many of the accepted functions of the liver are supported by little or no direct proof, and conclusions concerning its physiologic significance have been reached mainly by the process of elimination.

During the last three years in association with Magath and Bollman, in the Division of Experimental Surgery of the Mayo Foundation, an intensive and extensive study of the physiology,

of the liver has been carried out, chiefly with regard to the effects of removing the organ surgically. It was recognized that great care must be exercised in making deductions with regard to the functions of an organ from the changes that take place following its removal. However, the history of the development of our knowledge concerning the functions of many important organs shows that experimental surgery has been of the greatest value in determining the major function; among the important examples may be mentioned the pancreas, pituitary, thyroid, and adrenals. All our results on the effect of removal of the liver are of value in obtaining a conception of the physiologic significance of the organ, but a few may be of particular interest to the surgeon. I shall describe briefly our method of removal, the various procedures employed in studying the effect of loss of liver tissue, and the results.

The anatomic position of the liver makes its removal a much more difficult procedure than is the case with most other organs. The fact that the portal blood passes through the liver before returning to the heart, and the intimate relation between the liver and inferior vena cava, make it impossible to perform hepatectomy without interfering with the return of blood from the abdominal viscera and the lower extremities. Besides the problem of maintaining an adequate venous return from the viscera and lower extremities, the purely mechanical function of the liver in offering resistance to the diaphragm must be taken into consideration.

Most observations on the effect of removal of the liver have been made on the lower vertebrates, such as the goose, duck, frog, and other similar species in which there is normally a venous channel which allows the blood from the portal system to drain directly into the systemic venous system without passing through the liver. The liver may thus be removed without producing portal obstruction with its fatal consequences. Furthermore, the anatomic relation of the liver is such that the venous return from the lower extremities need not be impaired by its removal. Although the experiments on hepatectomy in the lower vertebrates have yielded valuable results, care must

be taken in interpreting them. For instance, while the natural anastomosis between the portal and systemic venous system does exist, in certain animals it is not sufficient to prevent slight portal obstruction after hepatectomy. In many instances all the liver cannot be removed. Such complications may cause erroneous conclusions. Moreover, the various phases of metabolism of the foodstuffs is not identical in these species with the same processes in higher species, such as man, and while such data are of great value in enlarging our knowledge of general physiologic processes, it can only be considered as an adjunct in connection with the course of the same processes in the higher species. Consequently it is of considerable importance to determine the effect of hepatectomy in mammals.

Removing the liver of the mammal is much more difficult than in the lower vertebrates. The portal blood must pass through the liver before it reaches the heart, and while there are anastomotic channels between the portal system and general venous system, such channels are wholly inadequate to return the portal blood. The relation of the liver to the vena cava is such that it cannot be completely extirpated without greatly damaging this structure. Hitherto the liver has been removed from mammals by various modifications of two general methods: first, the organ is removed only functionally; that is, the blood supply is obstructed, but the organ is left in the peritoneal cavity, and second, the liver is actually removed from the body. In each instance two general procedures are carried out; the most popular consists in making what is termed a "head-thorax preparation"; all the blood vessels, arterial and venous, are ligated below the diaphragm. It may readily be seen that this method removes other organs, in fact all organs in the abdominal cavity, as effectually as the liver. Less than half the body is under observation. The great splanchnic area, which is so important in regulating blood pressure, is destroyed. It is necessary to maintain the animal under an anesthetic throughout the period of observation. The many defects in removing the liver by this method, permitting as it does, sources of error in obtaining results and drawing conclusions, are obvious.

Making an Eck fistula and at the same time, or later, ligating the hepatic artery is the most common method of removing the liver. The liver is functionally removed by shutting off its blood supply, but the organ remains in the peritoneal cavity. It is apparent that there are certain serious objections to this method. With some of the vessels from the diaphragm entering the liver, a very small portion of it would have a blood supply. This, however, is probably of little practical significance, as the amount of liver tissue thus supplied is small. The main objection is the fact that the hepatic veins still drain into the vena cava, and the liver tissue has been left in the peritoneal cavity. Destruction of liver tissue cut off from its blood supply takes place very quickly. The tissue gives up its glycogen, and autolysis soon makes the organ almost unrecognizable. The products of such autolysis are very toxic, and usually gain entrance into the circulation through the open hepatic veins and by absorption from the peritoneal cavity. They not only decrease the length of life of the animal, but change the results of the blood analysis, giving the possibility of attributing to the function of the liver, something which is only due to its destroyed tissue.

The first experiments in which the liver was actually removed from the body consisted in removing also all the viscera drained by the portal vein. This had been termed the "evisceration method." There are two objections to the method. Since so many other viscera are removed, the results must be carefully analyzed before they can be attributed solely to loss of the function of the liver. The most serious objection, however, is the fact that the liver encompasses the vena cava so closely that in order to remove all liver tissue the vein is injured, and the venous return from the lower extremities accordingly obstructed.

Another much more valuable method of removing the liver consists in making an Eck fistula and later removing the organ, lobe by lobe. Here again the intimate relation of the vena cava and the liver makes it impossible to remove all the liver in this manner without injuring the vena cava. A minimum of approximately 10 per cent of the liver tissue must be left. Should

all of the liver be removed, the vena cava will be injured, producing circulatory destruction in both the viscera drained by the portal circulation and the lower extremities, while if some of the tissue is left without adequate blood supply it undergoes autolysis and produces a complicating toxemia.

Many of the most far reaching and important functions ascribed to the liver have been deducted from the results of experiments dealing with the effect of certain poisons which greatly damage the organ, such as phosphorus and chloroform. This method of removing the organ chemically, while of considerable value in demonstrating certain facts in relation to hepatic disease, is open to serious objections with regard to its employment as a means of elucidating facts concerning hepatic function. Our results with this method prove that the poisons, while greatly injuring the function of the liver, do not produce complete hepatic insufficiency except rarely. Other tissues and organs are undoubtedly profoundly affected, and in many instances the functional damage to the liver is probably not the primary cause of death. Unless great care is used in drawing conclusions from the results of experiments of this nature, functions may be ascribed to an organ which may be wholly due to general tissue damage.

Our method of removing the liver was developed with certain definite objectives in mind. First, we considered it necessary to have the return circulation of the abdominal viscera and lower extremities left intact, so that there would be no possibility of confusing the effects of loss of the liver with those due to portal obstruction and loss of function of other abdominal organs. Second, we considered it essential that all the liver should be removed, because as long as any of it remains, there is the objection that such tissue either functionates, or acts to produce toxins, depending on whether or not any circulation remains. Third, it seemed that if our observations and results were to be of more than questionable value, the final operation should be performed quickly, and in such a manner that the animal could recover from the anesthetic and operation, and be as nearly as possible in a normal physiologic condition and en-



vironment. These necessary conditions were accomplished as follows.

The liver was removed in three stages. All operations were performed under ether anesthesia with aseptic surgical technic. The first operation consisted of a reverse Eck fistula, that is, lateral anastomosis of the portal vein and vena cava, and ligation of the latter on the cephalic side of the stoma. At first a considerable portion of the blood from the posterior portion of the body passed through the liver, but since the capillaries of the liver offered more resistance to the flow of blood than was necessary for the development of collateral circulation through the azygos and internal mammary veins, most of the blood soon passed by way of the latter channels. The second operation consisted of ligating the portal vein at its entrance into the liver. This caused all the blood from the viscera and hind legs to return by way of the collateral vessels, the azygos and the internal mammary veins. If, as sometimes occurs, collateral vessels fail to develop sufficiently, as is recognized by congestion of the intestines after ligation of the portal vein, the occlusion of the portal vein is carried out in two stages. In such cases the ligature is removed from the vein which is partially occluded, by passing a blood vessel suture through the center and ligating one side. At a later operation the portal circulation is entirely occluded. The first two procedures have thus taken care of the circulation of the abdominal viscera and lower extremities, so that the third procedure quickly removes the entire liver. The time necessary for the final operation rarely exceeds one-half hour, and from the beginning of the anesthetic until the animal has recovered is only about two hours or less. A minimal of two weeks is required between the various stages, although much longer periods are desirable.

While our method of removing the liver requires considerable time and operating, it gives, as a final result, an experiment almost free from the misleading complications of all previous methods. It should be emphasized that in our experiments the liver is entirely removed, and the resulting experiment is not complicated by portal obstruction, anesthesia, or other

objectionable features. This has permitted the study of the effect produced by the absolute loss of the liver in animals in which few sources of error were present. The symptoms occurring and the various changes produced in the blood and other tissue could thus be attributed either directly or indirectly to the hepatectomy.

The results of our experiments on the effect of total removal of the liver in the dog, of which we have performed a very large number, as well as the experiments in which the liver was removed from duck, frog, fish, and turtle, have disclosed many facts with regard to the function of the liver; of these, only three will be discussed, (1) the relation of the liver to carbohydrate metabolism; (2) the relation of the liver to protein metabolism, and (3) the relation of the liver to the formation of bilirubin.

After the liver is removed from a dog, the animal recovers from the anesthetic, and for a few hours, usually from three to five, appears normal. During this time the animal will walk around, respond to call, and seem no different from an animal following anesthesia and other operative procedures. After a variable period the animal develops a characteristic group of symptoms, which in order of their occurrence are muscular weakness, loss of reflexes, muscular twitchings, and convulsions. The development of the symptoms is very constant. The time elapsing between the first symptoms of muscular weakness and death is seldom greater than an hour or two.

The symptoms of the animal, the pulse, respiration, and temperature, were carefully observed and analyses of the blood and urine made for their various constituents. A constant change of only one constituent of the blood seemed to bear any relation to the symptoms. It was noted that the blood sugar always decreased following hepatectomy, and that the level of the blood sugar bore a definite relation to the development and progress of the symptoms. When death occurred there was hardly a measurable amount of sugar in the blood. This constant finding of a decrease in blood sugar, and its definite relation to the various symptoms and death, led to the experiment of

the intravenous injection of glucose when the animal had low blood sugar, and was almost dead. The effect was most striking. The dog, which was comatose and perfectly flaccid, immediately got up and walked around, appearing to be normal. In a short time the blood sugar again was low and the animal moribund, and another injection of glucose restored it to normal. This cycle of decrease in blood sugar, occurrence of symptoms, and restoration to normal by the injection of glucose was kept up for a considerable period; the animal then developed a group of symptoms, which were not abolished by glucose, and death occurred. We next tried the effect of administering glucose immediately after removing the liver, and found that if the blood sugar level was maintained at normal or above, the first group of symptoms *did not develop*, but that after a variable period, which was always many times longer than if glucose had not been administered, the animal died following the development of the second group of symptoms. It made no difference whether the glucose was administered, intravenously, orally, or by jejunostomy, if the blood sugar level was maintained, the characteristic symptoms did not develop. Many substances other than glucose were administered, but the beneficial action was specific for glucose, or those substances which could be transformed into glucose in the blood stream. Estimations of the glycogen content of the muscle, before and after hepatectomy, showed a marked decrease in this substance after operation. As the blood sugar decreased after hepatectomy, the muscle glycogen decreased also, showing that this source of carbohydrate supply was being drawn on. It was also noted that the transitory hyperglycemias, those that follow anesthesia and operation, asphyxia and certain drugs, such as adrenalin, did not occur after the liver was removed. Nor did the more permanent hyperglycemia, that which occurs after the pancreas is removed, occur if the liver was removed. Furthermore, if the pancreas was removed some time previous to the removal of the liver, the blood sugar which had increased following the pancreatectomy, immediately decreased following the hepatectomy.

The experiments prove conclusively that the liver has a vital function in relation to carbohydrate metabolism. Normally the blood sugar level is maintained by the liver, and there is a certain critical level of the blood sugar; if it decreases below this point the body cannot function normally, and death will occur. The liver is essential for the maintenance of the blood sugar above this critical level. The exact mechanism by which the liver accomplishes this has not been determined.

The results of the removal of the liver on protein metabolism are as definite as those on carbohydrate metabolism, but they are possibly more difficult to explain. Normally the dog does not have uric acid in his blood, as this nitrogen constituent is further oxidized to allantoin. After the liver is removed, the uric acid increases in large amounts in the blood, showing that the operation has, in some manner, interfered with the normal oxidation of this substance. The creatinin-creatin metabolism is not affected. The amino-acids increase. The most striking effect on nitrogen metabolism is the immediate and seemingly absolute stoppage of the production of urea. The blood urea content of an animal from which the liver has been removed either decreases, or remains constant throughout the period of the experiment, depending on whether the animal secretes urine or becomes anuric. If the kidneys are removed from an animal, the blood urea will increase two or three times the initial amount within twelve to fifteen hours. If the liver is removed at the same time as the kidneys, the blood urea level remains the same after operation as before, regardless of the length of time the animal may live. Finally, if the kidneys are removed from eight to twenty-four hours before the liver is removed, so that at the time of hepatectomy the blood urea level is far above normal, no further increase in urea takes place.

These results would seem to indicate that there is a dissociation of the process which we usually term "protein metabolism." The liver does not appear to be specifically concerned in certain phases of protein metabolism. However, there seems to be no question but that the greater part of this important process depends on the action of the liver. Certainly protein

metabolism does not occur, as an orderly process, without the liver.

One of the most interesting observations relates to the jaundice which develops after hepatectomy. A specimen of urine obtained from a hepatectomized animal four to six hours after total removal of the liver has a definite yellow tinge, as though it contained bile. After three to six hours, the blood plasma also develops a faint yellow tinge which progressively increases throughout the life of the animal. A yellow tinge also develops in the sclera in animals that live more than twelve to eighteen hours, and sometimes the jaundice can also be seen in the mucous membranes. At necropsy all the fatty tissue of the body is a dirty yellow, and an extract of this fat is a canary yellow. The intravenous injection of hemoglobin greatly increases the amount of the pigment in the blood and tissues. This yellow pigment gives a positive reaction for all the present day tests for bile pigment, and there seems to be no doubt but that it is bilirubin.

There may possibly be four sources to the pigment: it may be squeezed from the liver at the time of operation, it may be absorbed from the bile present in the intestine previous to operation, it may have been stored in some organ previous to operation, or it may be made by certain tissues. That it was not squeezed from the liver at the time of operation is proved by the facts that it is not found in the plasma immediately after operation, that it progressively increases, and that careful clamping of the vena cava before hepatectomy did not prevent its occurrence. That it is not just an absorption of bile from the intestine is proved by the facts that removal of the gastrointestinal tract at the time of hepatectomy did not prevent its occurrence, and that the contents of the gastro-intestinal tract become pigment-free within a few hours after hepatectomy, while the pigments in the plasma progressively increase. That it has not just been stored in some organ previous to hepatectomy is evident in that the amount excreted in the urine and found in the plasma and tissue at death is too large to have been stored in any one organ or tissue without giving marked

evidence of its existence. We are, therefore, forced to the conclusion that this pigment is formed from some substance after hepatectomy. We have not as yet been able definitely to determine how the pigment is formed.

Our experiments have definitely proved that a true hematogenous jaundice can occur. Whether or not the pigment producing the jaundice is bilirubin cannot be asserted positively, but until a method is devised which will differentiate this pigment from bilirubin, we believe that it should be classified as bilirubin. Our experiments have also shown that the development of this pigment does not necessarily depend on the spleen, because it has appeared following removal of both the spleen and liver, and, it does not depend on the presence of blood in the serous cavities, because we have had it occur when blood was not present in the peritoneal or thoracic cavity. There seems to be a definite relation between muscular movement and the development of the pigment, but the amount of the pigment varies so greatly in the different animals, that a positive statement cannot be made with regard to this possible relationship.

This brief review of our work demonstrates that the function of the liver is intimately concerned with many of the most important and intimate physiologic processes. It is a vital organ in the sense that life without it is impossible for a long period. The liver is absolutely necessary for the processes of metabolism concerning the important foodstuffs, carbohydrate and protein. On the other hand, our experiments have shown that the liver does not play the predominant part usually ascribed to it with regard to several physiologic processes. It is not necessary for the formation of bile pigment. It is not directly of the greatest importance with regard to heat production, although indirectly in relation to the metabolism of carbohydrate and protein it is of importance. Thus far we have not been able to prove that the liver plays the important part in the so-called detoxicating function that has been attributed to it.

The part the liver may play in the surgery of the future cannot now be estimated. It is clear that with the present perfec-

tion of operative technic there must be a clear understanding, appreciation, and conservation of physiologic procedure if the patient of the future is to be operated on *more* successfully than the patient of today. In this consideration of physiologic compensation in relation to surgery, the liver, in all probability, will receive the attention which its size warrants.

## ACTINOMYCOSIS OF THE SIGMOID FLEXURE

EMMETT B. FRAZER AND DAVID M. BERKMAN

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*THE case of actinomycosis reported herewith is of interest because of (1) the location of the lesion, (2) the fact that the correct diagnosis was not made even by surgical exploration, and (3) the result of treatment.*

This man, fifty-five years of age, was admitted to the Clinic December 3, 1921. He complained of a growth in the left side of the abdomen with slight soreness. Fifteen years before, he had been struck in the left side by a seven-pound hammer, but no untoward effects were noted for several days, except local pain and soreness. About four weeks before admission to the Clinic he first noticed the small lump in the left iliac region. It rapidly increased in size and soon seemed to occupy the entire left iliac area. There was slight tenderness, but no pain. Two weeks later an exploratory laparotomy had been performed elsewhere, and the surgeon reported the condition to be inoperable carcinoma, but this was not proved histologically; the pathologist reported the specimen submitted for examination to be inflammatory. A Wassermann reaction on the blood after operation was "weakly positive". The test was not repeated. The patient had lost only about 10 pounds in weight in several years. He was slightly constipated, and for twenty years had suffered from hemorrhoids, which bled at times, but he had never passed blood by rectum. His appetite and digestion were good.

At examination marked dental sepsis and a large, very hard, non-nodular mass filling the entire left lower abdominal quadrant were noted. There was a recent scar, about 10 cm. long, over this area. In the suture line and at points where the sutures had entered the skin, there were several sinuses discharging a thin,





## CARCINOMA OF THE RECTUM, RECTOSIGMOID, AND SIGMOID

LOUIS A. BUE

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A STATISTICAL study of the results in cases of carcinoma of the pelvic colon observed at the Mayo Clinic has been made from a review of the histories of 1,937 patients who came to the Clinic between January 1, 1910 and December 31, 1922 for treatment of this condition. Eighty-six and seven-tenths per cent of the patients were over forty years of age. Sixty-eight per cent were males, and 32 per cent females. Two hundred seventy-eight of the 1,937 cases were considered inoperable, and were studied separately. To determine the relation between various types of operative treatment and mortality, the surgical records from 1916 to 1922 were studied, because greater detail was given than in the earlier records. These records cover 1,457 operations on 1,022 patients.

### SYMPTOMS AND DIAGNOSIS

In 355 of the 1,937 cases the symptoms were recorded in detail. From a study of this smaller series, it was found that the chief complaints were bleeding (40 per cent); pain (39.4 per cent), increasing constipation (31.83 per cent); diarrhea (20.84 per cent), and obstruction (7.32 per cent). These figures will not total 100 per cent because frequently several symptoms were combined in the patient's complaint, and each symptom was recorded. Associated complaints, such as deformed stools, pruritus, poor control, and so forth (Table 1), were not referred to by the patient as the chief disorder, and were ascertained only by questions in the routine taking of the history. Twelve per cent of the 355 patients had no loss of weight; 75.52 per cent lost over 10 pounds, and 50 per cent lost over 20 pounds.

TABLE 1  
CHIEF COMPLAINT

	Cases	Per cent
Stated in . . .	355	
Bleeding . . . . .	142	40 0
Pain . . . . .	140	39 4
Increasing constipation	113	31 83
Diarrhea . . . . .	74	20 84
Obstruction . . . . .	26	7 32
Associated symptoms*		
Bleeding . . . . .	608	84 0
Constipation	608	59 3
Pain . . . . .	132	67 4
Diarrhea . . . . .	608	26 6
Urinary symptoms	476	25 4
Deformed stools	132	14 4
Pruritus . . . . .	132	3 8
Poor control . . . . .	476	1 48

The duration of symptoms is one of the chief points in differential diagnosis between benign strictures and malignancy. In the former few patients who come to the Clinic give histories of less than two years' duration, whereas in the latter the disease rarely permits the patient to live longer than two years unless surgical or other treatment is given. In this series the duration of the symptoms was usually less than two years; in only 6.7 per cent of the cases had the symptoms been present more than three years. In 82.7 per cent the duration was less than two years, in 49 per cent, less than one year, and in 21.1 per cent, less than six months.

A study of the relative location of pain brings out the fact that, in low-lying lesions, pain in the rectum is most common, and abdominal pain less common. In high lesions, the reverse is true. Pain in the back and sacrum was greatest in cases of low-lying lesions, and decreased with the height of the lesion, whereas abdominal pain increased with the height of the lesion.

#### HEMOGLOBIN REPORTS

In the series of 1,937 cases, 1,150 hemoglobin reports were available. In two cases the hemoglobin was less than 20 per

\* Based on three groups of cases.

cent; in thirteen, between 20 and 29 per cent; in nineteen, between 30 and 39 per cent, and in thirty-nine, between 40 and 49 per cent. In 93.3 per cent, the hemoglobin was over 50 per cent, and in 63.4 per cent it was within normal limits.

#### ROENTGENOLOGIC AND PROCTOSCOPIC EXAMINATIONS

Roentgenologic reports were available in 320 of the 1,937 cases. Two hundred twenty-two were positive. Roentgenograms of the rectum were positive in 46.34 per cent; of the rectosigmoid in 72 per cent, and of the sigmoid in 90.98 per cent. One patient had metastasis to the skull, but in the relatively few roentgenograms of the spine and pelvis there were no evidences of metastasis.

It is noteworthy that only 26 per cent of the patients with essential rectal disorder had been examined proctoscopically before coming to the Clinic, and that 18 per cent had received medical or surgical treatment for hemorrhoids during the period of their presenting symptoms, without proctoscopic examination.

Of the 278 cases considered inoperable, roentgenograms of the chest were taken in 110. In nine (8.18 per cent) metastasis to the lung was evident. One hundred seventy-three proctoscopic examinations were made in the 278 cases. The lesion was located in 171 cases. The other two were reported negative for 24 cm., and in both of these cases the colon ray revealed "filling defects in the sigmoid."

#### MORTALITY FOLLOWING OPERATIVE TREATMENT

One thousand four hundred fifty-seven operations were performed on 1,022 patients between January 1, 1916 and December 31, 1922. The operability and mortality percentages are based on the number of patients operated on, and not on the number of operations, and any death which occurred in the hospital following operation for carcinoma of the pelvic colon was charged as an operative mortality, even if complications arose in the lung, kidney, or other organs, and caused the patient's death.

In a review of this particular subject the ratio between radical and palliative operations has a distinct bearing, and has therefore been worked out accurately. We would expect that with an increase in operability, there would be a corresponding increase in mortality; that is, if we selected carefully for operation twenty-five out of every 100 patients who come in, we would expect to make a much better showing than if we attempted to operate on seventy-five out of every hundred. This has not proved to be the case in the series reported here, as is quite

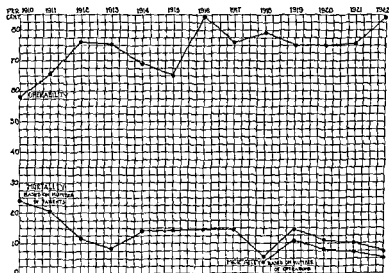


Fig. 105—Curve showing decrease in mortality rate as operability is extended (Based on 1,937 cases)

clearly shown by the curve (Fig 105). In spite of the decided extension of operability, the mortality has gradually decreased. It is quite probable that the improved preoperative preparation and the improvement in surgical methods and technic are to a great degree responsible for this gratifying result. The increasing use of two-stage operations is doubtless a contributing factor, and the ratio between palliative and radical operations also has a decided effect on the mortality curve. Moreover, the use of sacral anesthesia has materially reduced the risk of operation

(Fig. 106). Of the 1,022 patients operated on, 693 (67.8 per cent) underwent radical operations. The mortality has been

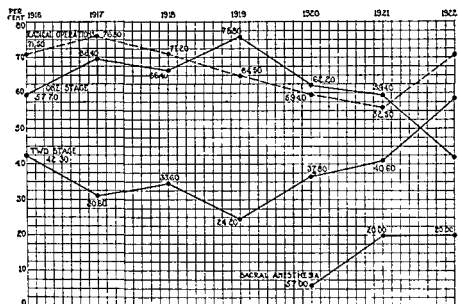


Fig. 106 —Curve showing the relation of one- and two-stage operations to mortality. (Based on 1,022 cases )

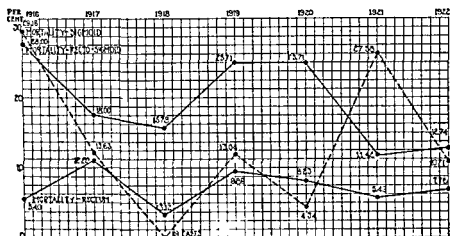


Fig. 107.—Curve showing the comparative mortality in operations on the rectum, rectosigmoid, and sigmoid (Based on 1,022 cases.)

highest for carcinoma of the rectosigmoid (Fig. 107), it being 18.3 per cent; for carcinoma of the sigmoid, it was 14.5 per cent; and of the rectum, 7.44 per cent. It was found that each

year the curve of mortality went in the opposite direction to the curve representing the number of two-stage operations, and that, if more two-stage operations were performed, the mortality was lowered; moreover, in 1921 and 1922 the mortality rate remained low in spite of the fact that the number of radical operations increased, because there was a decided increase in the number of two-stage operations for carcinoma of the rectum. The types of operation performed in the cases reported here are shown in Table 2.

TABLE 2  
TYPES OF OPERATION PERFORMED

	Rectum	Recto-sigmoid	Sigmoid	Total cases	Per cent.
Three-stage Mikulicz		13	43	56	11.5
Two-stage Mikulicz		5	13	18	2.4
One-stage Mikulicz		2	4	6	0.4
Resection (end-to-end anastomosis)	4	16	24	44	3.0
Tube resection		26	16	42	2.8
Resection and colostomy		2	6	8	0.5
Combined colostomy and posterior excision	1			1	0.06
Two-stage resection	222	79	6	307	42.0
Combined posterior and anterior resection and permanent colostomy			1	1	0.06
One-stage posterior resection		14		14	0.96
One-stage Kraske resection			1	1	0.06
One-stage combined perineal and abdominal resection and colostomy	9	6		15	1.03
Entero-anastomosis			3	3	0.25
Quenu-Tuttle	11	1		12	0.8
Cautery	4			4	0.27
One-stage posterior excision	133			133	9.1
Abdominal excision		1		1	0.06
Excision of growth	3			3	0.23
Excision and cautery	2			2	0.13
Incision, dilatation, and colostomy	1			1	0.06
Harrison-Cripps	12			12	0.82
Miscellaneous (enterostomy, cecostomy, ileostomy, ileosigmoidostomy)	2	6	5	13	0.89
Colostomy	162	69	29	260	10.9
Exploration	21	25	17	63	4.3
Total patients operated on	587	265	168	1,020	
Total operations performed	1,457				

## INOPERABLE CASES

A closer study was made of the 278 cases in which operation was not performed to ascertain why they did not come to operation. It was found that 43 per cent of the patients were advised to have an operation, but for various reasons did not. Thirty-one per cent of the remainder had palpable glands in the groin, axilla, neck, or pelvis; 2 per cent had glands in the abdominal wall; in 8.18 per cent of the 110 cases in which roentgenograms of the chest were made, there was metastasis to the lungs; one patient had metastasis to the skull, and 14.8 per cent had palpable nodules in the liver. Six per cent of the patients were over seventy years of age, and three patients over eighty years. During the twelve months previous to registration at the Clinic 29 per cent had undergone colostomy, and had been pronounced inoperable, or had had a Kraske operation, or resection, with recurrence; or had been treated with radium and roentgen rays. Almost half the patients (41.2 per cent) had lesions that were fixed.

## DISCUSSION

Too many patients with cancer of the pelvic colon are operated on for hemorrhoids without a previous examination, and at the time of the operation carcinoma is found for the first time. Certain cancers of the lower bowel metastasize to the lung, and it is therefore necessary routinely to examine the lungs with the roentgen ray. The three outstanding reasons for the reduction in operative mortality are: (1) improved surgical technic; (2) increased number of two-stage operations, and (3) sacral anesthesia. Surgeons are becoming more radical in their attempts to help more patients, and this is evidenced by the increase in the operability in twelve years from 56 to 84 per cent.





## TUBERCULOMAS OF THE BOWEL

PHILIP W. BROWN

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TUBERCULOSIS must be considered as a generalized systemic disease, although the factors of individual resistance and virulence of the infecting bacillus may result in the localization of the disease process. This view has recently been re-emphasized by Lemon, who urges us to regard the disease in this broader aspect.

Tuberculosis manifests itself in the intestinal tract chiefly as ulcerative enterocolitis and hyperplastic tuberculosis. The French appended as a subdivision of the hyperplastic type the stenotic type, in which organization supplants destruction of tissue. Ulcerative enterocolitis is almost invariably associated with foci of active tuberculosis elsewhere and, unfortunately, is often a warning that the disease has already won against the defences of the body. On the other hand, the hyperplastic tuberculous lesions of the bowel, for which the term "tuberculoma" is used, represent a distinct clinical entity rather than a complication. Perhaps, in some cases, it may be considered a reactivation of tuberculosis elsewhere in the body, or an old intestinal lesion slowly beginning to produce symptoms. It is this variety of the disease that is of especial interest because of the difficulty of diagnosis and of treatment. To serve as a basis for such a study, thirty-two proved cases of tuberculomas which were observed in the Mayo Clinic from January, 1919 to November, 1923 were selected. Cases of tuberculous peritonitis, and tuberculous enterocolitis, and those of deformity of the colon, probably tuberculous, but giving evidence of more or less active ulceration, were not included. Therefore the cases selected fall into the somewhat arbitrary classification of tuberculomas. In this five-year period there was a larger number

of patients with a history and physical and roentgenologic findings of tuberculoma of the bowel, but the severity of the intestinal symptoms, in conjunction with active pulmonary tuberculosis, was not sufficient to warrant operation at this time, and only the surgically proved cases were selected for study.

It is recognized that there may be a less severe type of ulcerative colitis with resultant fibrosis, as in chronic ulcerative pulmonary tuberculosis. Further, it is possible that the bodily resistance may continue to increase, the active focus elsewhere become quiescent, and the fibrotic bowel changes outstrip the destructive process. Hence, in time, such a case might be classified as hyperplastic tuberculosis. Several cases in this series probably fall into this classification, the favorable evolution or healing mechanism of the disease.

The question whether intestinal tuberculosis is of the bovine or human type remains undetermined; also, whether the disease can be primary in the bowel. The British Commission, in 1911, finally proved the infectiousness of both types of bacilli. Wang, at the University of Edinburgh, presented an elaborate study on the differentiation of the bacilli. He concluded that 70.3 per cent of the tuberculosis in children from five to sixteen years of age and 7.8 per cent of that in adults was of the bovine type. He further asserted that when the primary entrance of the bacillus was in the intestine, as judged by pathologic changes (Cornet's law), the incidence of bovine tuberculosis was 60 per cent in adults and 90 per cent in children. Cobbett believes that the bovine type is more common in the intestine than in the lungs, but did not prove his statement by cultures as did Wang. This is a very strong argument for the more rigorous extermination of bovine tuberculosis. Nothnagel holds that hyperplastic tuberculosis may arise either from the swallowing of bacilli secondary to a pulmonary lesion, or from the ingestion of tuberculous meat and milk. The second group, therefore, may be the primary type of intestinal tuberculosis.

My series comprises thirty-four cases, two of which illustrate the nonsurgical type, and show what may be gained by conservative treatment. In the remaining thirty-two, operations

was performed, and the findings noted in full by the surgeon. Males outnumber the females (twenty-three to nine), the average age of the former being 34.6 years, and of the latter 36.2 years. The average age is in striking contrast with the average cancer age. Although there were ten patients more than forty years of age, the larger number (70 per cent) were less than forty. The factor of heredity or, more accurately, of early association with members of the family who were tuberculous, is not likely to be greater than in any other medical group. The duration of symptoms, which varied from two months to fifteen years, averaged three and eight-tenths years, which was, again, longer than the average duration of malignant symptoms. Eighteen per cent had trouble less than a year, while 70 per cent complained of trouble for one and one-half years or more. There was evidence of a tuberculous focus elsewhere in sixteen men and six women.

To give a more accurate conception of this disease process the cases have been classified according to the surgical findings. Group 1 includes those in which the tuberculous process was limited to the ileocecal region; Group 2 includes those in which there was ileocecal involvement and involvement of one or more localized areas in the small bowel, and Group 3 those in which there were one or more lesions of the small bowel, and none of the colon.

**Group 1. Localized hyperplastic ileocecal tuberculosis.**—There were twenty cases in this group. The average age of the patients (thirty-five years) and the duration of symptoms (three and one-tenth years) are longer than in cases of malignancy, with which this type is so often confused. Constipation or normal bowel movements are the rule; diarrhea is less frequent and usually bears a relation to the amount of reflex irritation initiated by ulceration. Of the twenty patients, twelve were constipated, five had normal bowel movements, and three had diarrhea. The more hyperplastic and fibrous the process, the less probable ulceration will be. Eleven of the patients complained of recurring attacks of lower right abdominal pain, with or without nausea and vomiting. The history is sug-

gestive of recurrent appendicitis. Seven patients suffered with indefinite abdominal cramp-like pains, usually more to the right of the umbilicus; nausea or vomiting was noted in the more severe attacks.

Roentgenograms of the colon were positive in nine cases, negative in four, and were not taken in seven. Roentgenograms of the chest revealed healed tuberculous lesions in four cases, active lesions in six, and were negative in nine. In the remaining case the history and physical examination indicated the presence of pulmonary tuberculosis.

In this group were two cases in which the lesion was rather an accidental finding. A man aged twenty-three years came to the Clinic with a slight cough and the question of gonorrheal infection. In the course of the examination, a movable, kidney-shaped tumor was felt in the right lower quadrant. The patient completely disclaimed any gastro-intestinal or renal symptoms. One specimen of urine voided prior to manipulating the mass was normal; following the manipulation there was slight hematuria. Roentgenograms of the kidneys, ureters and bladder, and cystoscopic examination were normal. A roentgenogram of the colon revealed a filling defect of the cecal region, and one of the chest, a questionably active lesion at the right upper lobe. The tumor was diagnosed as tuberculous, and on resection was found to be slightly adherent to the region of the right ureter posteriorly, which probably explains the transient hematuria. Unfortunately the patient died three days after operation of bronchopneumonia. The second case was that of a Sioux Indian woman, aged twenty-four years, who complained of having had six attacks of upper right and epigastric pain, simulating gallstone colic of two months' duration, with constipation, and tenderness over the right upper quadrant. Roentgenograms of the chest were negative. A diagnosis of gallstones was made. At exploration the gallbladder seemed normal, but there was a tuberculoma of the ileocecal region. This was resected, but the symptoms persisted, and finally a second operation was performed, when a hemorrhagic pancreatic cyst was found. Following drainage of the cyst the patient seemed to recover com-

pletely. These two cases apparently illustrate the chronicity and relatively inactive process which tuberculosis may exhibit in certain resistant soils. In fact, the stenotic feature may so predominate that the patient suffers from the gradual obstruction rather than from the tuberculous process. For example, a patient complained of constipation and indefinite abdominal pains and reflex gastric symptoms of five years' duration. Active tuberculosis of the upper left lung was found. Roentgenograms of the colon revealed a filling defect of the cecum and ascending colon. Exploration was advised because of the possibility of future obstruction. W. J. Mayo operated and found what he considered clinically to be healed hyperplastic tuberculosis. On account of the extensive adhesions resection was not advisable and an ileocolostomy (transverse colon) was performed. The convalescence was uneventful.

A striking feature of the surgical findings was that the last 5 to 15 cm. of the ilium was involved. In only one case did both surgeon and pathologist believe that the disease existed in the appendix. Lartigau has observed that the appendix usually escapes the tuberculous process. On the other hand, there were definite cases of appendicitis, but the tuberculosis occurred chiefly in the cecum and ileum. Tuberculosis of the appendix is very rare in conjunction with ileocecal tuberculosis. Furthermore, MacCarty says that he has never seen a case of primary appendiceal tuberculosis. Appendiceal tuberculosis is almost always secondary to peritoneal tuberculosis. Cecal stasis, the reversed peristalsis of the ascending colon, and the richness of the lymphoid structures may be possible factors in the localizing of the disease to the cecum and ileum.

Two patients in this series had had exploratory operations elsewhere, but surgical intervention was not undertaken because the tumorous mass was considered malignant, and the abdomen was closed without a specimen being taken for pathologic examination. In both cases the operative diagnosis was extensive carcinoma of the bowel. Later, at operation at the Clinic, the tumor was removed, and the pathologist's report in both cases was tuberculoma.

**Group II. Tuberculomas of the ileum and ileocecal region.—**

In the six cases in this group the disease seemed to attack several different areas of the intestine. The tuberculoma spreads along the transverse axis of the intestine in the direction of the blood vessels. It eventually forms a ring-shaped lesion which is referred to as the tuberculous girdle ulcer (Nothnagel). The average age of the patients was thirty-two years, and the symptoms extended over a period of less than three years (two and nine-tenths years). Only one patient complained of alternating diarrhea and constipation, which is sometimes thought to indicate disease in both the ileum and colon (Archibald). Three patients were constipated, one had diarrhea, and one, a normal stool. The colon ray was positive in four cases. Three of the six patients had active lesions in the lung, and two had healed lesions. There was no evidence of tuberculosis elsewhere in one case. The chief complaints in two cases were similar to those in most of the cases in Group 1, that is, symptoms referred to the right iliac fossa. Four patients had cramps and colicky pains in the region of the umbilicus. Mackenzie emphasizes this area as the one to which pain is referred from the small bowel, and which, therefore, may afford a symptom suggesting the diagnosis. From the surgical viewpoint these cases offer less than those of Group 1 as the multiplicity of the tuberculomas contraindicates surgery unless the ileac lesions are close enough to the ileocecal valve to permit their being resected with the cecum. This latter condition existed in only two of the cases. In four cases so many tuberculomas were found throughout the ileum that surgery was not considered. In two of these, neoarsphenamin was administered, this phase of treatment having been successful in certain cases of tuberculous dermatoses. In neither case was there any evidence of syphilis. The first patient made an excellent recovery. Roentgenograms of the colon a year later showed that the filling defect had almost completely disappeared. During the convalescence the patient lived in Arizona, and therefore the factors of rest and sun must also be considered. Her condition was so good in three years that she married. In the second case, however, the results were far less

striking; it was doubtful whether the patient was at all improved at the end of the year.

**Group III. Multiple lesions of the small bowel.**—In the six patients in this group the disease process had involved multiple areas throughout the ileum, and occasionally a tuberculoma was found high in the jejunum. Kaufmann says that the tuberculoma is usually single, but multiple ones also occur rather commonly, especially in children. Some tend to ulcerate, while others become fibrotic, causing stenosis. The area of bowel between the lesions is likely to be hypertrophied. The average age of these patients was thirty-eight years (ranging from twenty to fifty-one), and the duration of the symptoms four and nine-tenths years. These patients all complained of indefinite cramping pains, which seemed to be greatest around the navel. Another usual feature was that distress occurred soon after eating, not at a regular hour, but depending on the distance of the first tuberculoma from the pylorus. Nausea and vomiting were more constantly observed in this group. One patient had diarrhea; another had alternating spells of diarrhea and constipation; the remainder were constipated. The outstanding symptoms at the time the patient was seen here were those of chronic intermittent obstruction. Usually severe, periodic mid-abdominal cramps, with nausea and vomiting were the chief subjective complaints. The degree of obstruction determined the severity of clinical symptoms. In three cases the obstruction was so severe that the weight loss averaged 55 pounds. Roentgenograms of the colon were of little assistance, being essentially negative in all instances. Two patients had active pulmonary lesions, and one had chronic osteomyelitis of the ilium, making three with a possible focus of tuberculosis elsewhere. The other three patients presented no evidence of any other focus of tuberculosis.

One patient presented a complex of symptoms of unusual interest. For three years he had suffered from intermittent attacks of diarrhea and asthenia, and in that time had lost 20 pounds in weight. A short time before his examination he had observed that gas often passed from the urethra following



urination. There was no evidence of irritability of the bladder. Repeated stool examinations were negative for the tuberculosis bacillus. The roentgenograms of the colon and of the chest were negative, although the history pointed to attacks of possible disease in the lungs. Cystoscopic examination revealed a very small spot in the wall of the bladder, which the urologist "thought" might be the fistulous opening between the bowel and bladder. W. J. Mayo explored and found that the ileum contained many tuberculomas. One of these adhered to the dome of the bladder, producing a fistula. Because of the multiplicity of lesions an ileocolostomy was made in order to short circuit around the site of the tuberculoma which was adherent to the bladder. The convalescence was uneventful and, at the last report, one year later, the patient was doing well.

It is important to note that all six patients had multiple tuberculomas, so that the practicability of surgical intervention and the type of operation could only be determined after exploring the abdomen. In consequence of the multiplicity of lesions the prognosis is guarded.

#### CASES OF "PRIMARY" INTESTINAL TUBERCULOSIS

In this series of thirty-two patients there were ten in whom no focus of tuberculosis outside the intestine could be demonstrated. In three more patients there was no evidence of other foci, but as x-rays had not been made of the chest, they were excluded. The origin of the disease in the ten apparently primary cases cannot be proved, but the possibility of infection from diseased meat or milk is reasonable. Eight of the patients came from rural districts, although this fact is of little significance.

Nine of the ten patients had a tuberculoma of the ileocecal region, the typical hyperplastic lesion. In four of these the masses were palpable. The other patient had an additional tuberculoma of the ileum, 18 cm above the ileocecal valve. In the differential diagnosis of carcinoma and tuberculoma, the average age of thirty-six years, the average duration of symptoms of five years, and the average weight loss of only 25 pounds for

this time, are three helpful points in establishing the probability of tuberculoma. On the other hand, one patient, aged sixty years, came to the Clinic complaining of nausea, vomiting, right abdominal and epigastric pains, all lasting only four months. The patient had lost 60 pounds. An x-ray of the colon revealed a lesion of the cecum and ascending colon, which was considered malignant. Operation disclosed hyperplastic tuberculosis of the ileocecal region, but no evidence of malignancy. In retrospect, the blood count was unusually high for such an apparently serious malignancy; the erythrocytes numbered 4,740,000, the leukocytes 8,500, and the hemoglobin (Dare) was 74 per cent. Also the extent of the filling defect as shown by the roentgenogram was unusual for a carcinoma.

From the clinical standpoint it does not seem possible to distinguish tuberculoma from carcinoma. The localization of a lesion is entirely sufficient to recommend operation. If malignant, surgery as soon as possible is the only hope; if tuberculous, resection offers good hope for permanent cure. It is important not to consider the tumor malignant, when the abdomen is open, closing the wound without doing anything for the patient, as was done in the two cases previously mentioned. Actinomycosis, gumma, and the pyogenic type of granuloma may give similar clinical pictures, but are far less common than tuberculoma and carcinoma.

#### SUMMARY

Tuberculomas of the intestinal tract are localized manifestations of tuberculosis and, by virtue of being localized, present a difficult problem in the differential diagnosis.

The average age and duration of symptoms are among the more important features in distinguishing tuberculoma from carcinoma, but the impossibility of making a definite diagnosis had been illustrated in several cases, particularly in older people.

Primary intestinal tuberculosis may occur, and 30 per cent of the patients in this series seem to belong to this group. The lesions may arise from infection conveyed by tuberculous meat and milk, which emphasizes the necessity of more rigorous

atemesis have not been noted. His normal weight was 215 pounds.

On examination we found that his pupils reacted normally, but his mouth revealed the most extreme degree of dental sepsis. His heart was enlarged both to the right and left, the tones were of poor quality and roughened, and occasional dropped beats were noted. The arteries were extremely sclerosed, and the brachials tortuous. His chest was emphysematous throughout, with some crackles at the right axilla and base. There was crepitation and limitation of motion of both shoulders and the left knee. The arms could not be raised above the level of the shoulders. In the abdomen was a large rounded tumor filled with fluid, extending to the umbilicus from the pubes. Tympany was noted over the remainder of the abdomen and in the flanks. The prostate was moderately enlarged, and above it could be felt the distended bladder. There was marked edema of both extremities, and a left hydrocele. The systolic blood pressure was 126, the diastolic 66, the pulse 84, and the temperature 98.6°. The patient was put to bed, and sufficient blood obtained for the determination of the urea and creatinin contents, and for blood grouping. One hundred cubic centimeters of blood contained 276 mg urea and 8.4 mg creatinin. The patient was in blood Group 2. The Wassermann reaction was negative. The hemoglobin was 34 per cent, the erythrocytes numbered 2,300,000, and the leukocytes 8,800. The bladder was not immediately emptied, but a rubber tube, approximately 180 cm long and filled with water, was attached to a catheter that had been placed in the patient's bladder. It was thus determined that the pressure within the bladder would sustain a column of water 40 cm high. A receptacle for collecting the urine was hung at this height and the urine allowed to flow out through the long tube. In the first twenty-four hours 6,500 c.c. of urine was collected, which had a specific gravity of 1.010, and contained approximately 25 pus cells to the microscopic field. There was no sugar and only a trace of albumin. At the expiration of twenty-four hours, with rest in bed, the tension in the bladder had dropped to 30 cm, and the

receptacle was accordingly lowered. Following this procedure five days were consumed in emptying the bladder. The systolic blood pressure, which had been 160 at the time of the first examination, declined rapidly. On the ninth day it reached a minimum of 100; the diastolic pressure remained approximately 70. The output of urine during the first ten days exceeded 4,000 c.c. each day. After this it established a constant ratio with the intake, and remained approximately 3,000 c.c. The urea content of the blood decreased daily, averaging approximately 20 mg., and the creatinin values declined correspondingly; on the twenty-seventh day the urea was 70 mg. for each 100 c.c. of blood, and the creatinin 2.5 mg. On the thirty-seventh day the patient was deemed in sufficiently good physical condition to warrant a cystostomy.

The renal function, as tested by phenolsulphonephthalein, showed a 10 per cent excretion in two hours, the urea was 60 mg. for each 100 c.c., and the creatinin had returned to within normal limits.

Following the operation the left side of the scrotum became swollen and tender, and there was a febrile reaction. On the tenth day, since there was no apparent improvement, orchidectomy was performed. The patient recovered from this without incident and continued to wear a suprapubic tube for the next four months. His general improvement was gradual, but steadily progressive; he gained an average of 10 pounds a month. The hemoglobin returned to normal and the phenolsulphonephthalein output rose to 25 per cent. Prostatectomy was performed approximately four months after the initial operation, and his convalescence has been uneventful. (Note: This patient left the hospital after thirty-one days. His suprapubic wound was healed, and he was sufficiently robust to carry his suit case and belongings from the hospital to the railroad station, a distance of a quarter of a mile.)

#### DISCUSSION

This case presents many problems met with in the preparation of elderly patients for prostatectomy: first, emptying the

overdistended bladder so that edema and congestion of the urinary tract will not occur following diminution of intravesical pressure; second, instituting eliminative measures to reduce the marked urea and creatinin retention to a point consistent with operability; third, changing the type of urinary drainage from that of a urethral catheter, always associated with some urethral irritation, to suprapubic drainage; by placing the urethra at rest the prostatic congestion is diminished; fourth, caring for a complicating epididymitis, common in this type of case, and fifth, determining when a suprapubic prostatectomy may be undertaken safely.

#### GRADUAL EMPTYING OF AN OVERDISTENDED BLADDER

It is generally recognized that the removal of urine from a chronically overdistended bladder is often followed by untoward symptoms or death. If the bladder is emptied rapidly and completely at one time, the sudden reduction of the intravesical pressure causes immediate congestion throughout the urinary tract, with resulting edema and hemorrhage which may be so severe as completely to suppress renal function by increasing the pressure within the renal capsule to a point incompatible with glomerular and tubular function. The process may not go on to complete suppression of urine, but the congestion and edema make the urinary tract a fertile field for infection, a complication borne very poorly by this group of patients, and is undoubtedly the cause of many fatalities. Accompanying the congestion there is usually a decided fall in blood pressure during the first forty-eight hours, which tends still further to diminish the urinary output. If the bladder is emptied gradually, as in this case, thereby maintaining a constant but diminishing pressure, the change in blood pressure becomes more gradual and the excretory mechanism more readily adapts itself to the change. Five days were consumed in emptying the bladder, with the result that the blood pressure did not reach the maximal fall until the ninth day.

## ELIMINATIVE MEASURES

Since the eliminative function of the kidneys is reduced, the skin and bowels must be forced to take over a maximal amount of this function, and the kidneys themselves be utilized to the total extent of their diminished function. To do this, fluids should be forced to a point that will not embarrass the heart or result in edema, and when a portion of the intake is derived from sodium chlorid solution placed under the skin, the results are better than when all the fluids are given directly into the gastro-intestinal tract either by mouth or by rectum. This patient was given 1,000 c.c. of sodium chlorid solution daily for the first ten days, after which it was given every other day for a week. This, with the fluids taken by mouth, and by proctoclysis, resulted in a daily intake of approximately 4,000 c.c., and an output of between 2,500 and 3,000 c.c. Immediately after the administration of the sodium chlorid solution subcutaneously the patient would be put in a hot pack and a profuse sweat produced. It may seem incongruous to place a patient with a fever of  $103^{\circ}$  or  $104^{\circ}$  into a hot pack, but if the fever is of renal origin it is surprising how rapidly it responds to this type of treatment.

There are, of course, many methods in vogue for inducing sweating, each having its advantage, but for the general hospital where nurses are in training and the services are rotating, nothing in our experience has proved so useful and efficient as an electric blanket which, in construction, corresponds to the electric pads. This prevents burns from hot-water bottles in cases in which the patients are often uremic. This blanket gives a uniform heat over the entire body; the heat is readily applied, and can be switched off as soon as the patient has commenced to sweat. When sweating cannot be induced by heat alone, aspirin in from 5- to 10-grain doses will be effective in nearly every case, if given ten or fifteen minutes before placing the patient in the pack, but if it fails, pilocarpin may be used, due care being taken that there are no pulmonary complications, as edema of the lungs has occurred following its administration. Magnesium sulphate is the most valuable cathartic for causing

a rapid exchange of fluids from the tissues, there should be copious, loose stools daily until the urea and creatinin values begin to decline. Although on admission this patient had a degree of urea and creatinin retention usually associated with an absolutely fatal prognosis at the end of three weeks, the urea had declined 140 mg for each 100 c.c. of blood, and the creatinin had decreased 50 per cent.

#### TYPE OF URINARY DRAINAGE

A patient with prostatic obstruction, usually as a result of attempting to empty his bladder, has marked congestion of the neck of the bladder, besides the adenomatous hypertrophy of the gland. This is often increased by secondary infection. Therefore, in all critical cases in which the patient's general condition will permit, suprapubic drainage should be established at once. This places the urethra at rest, abolishes the attempt of the bladder to force urine past the obstruction, and reduces the infection, with the result that the prostatic congestion and edema will subside, and at a subsequent operation the gland will be much easier to enucleate and there will be less bleeding. Suprapubic drainage is, however, not always possible because of the patient's poor general condition, as in this case, in which early surgical interference would probably have proved fatal. In such cases it is well to wait until eliminative measures have produced a decided fall in the urea contents of the blood, or the phenolsulphonephthalein output has commenced to increase. In this case a cystostomy was performed after five weeks of drainage by means of a urethral catheter. During this period the phenolsulphonephthalein had increased from 0 to 10 per cent, and the urea had dropped from 240 to 60. The creatinin was normal. The disadvantage of drainage by the urethral catheter is that the catheter tends to continue the prostatic congestion by the constant irritation to the urethra.

#### EPIDIDYMITIS

The complication of epididymitis which occurred in this case immediately following the operation is quite common during

either the preoperative or postoperative treatment. It seems to bear no relation to catheterization, as it is often met with when suprapubic drainage has been used from the beginning. To prevent epididymitis certain surgeons advocate tying the vas at the time of operation, but this would not prevent the high preoperative incidence. Happily the complication is not common enough to warrant so radical a prophylactic measure. If the condition is seen at the onset it can be aborted by keeping the patient in bed with the testicles elevated and ice applied. No satisfactory mechanical supporter has been found; the usual suspensory constructed for a man in the ambulatory posture is obviously inadequate, as it usually exerts pressure on the scrotal perineal angle and helps produce chronic passive congestion and edema. A small pillow or towel placed between the legs on which an ice-bag is laid serves as the most satisfactory support. The patient should be impressed with the importance of keeping the testicles on the ice-bag, not the ice-bag on the testicles. If the ice is left in place for seventy-two hours the epididymitis will usually subside. After the third day ice is of little value, and may be advantageously abandoned for heat. If the process is progressing, the heat will tend to bring the brawny edematous inflammation to the stage of fluctuation; the testicles may then be incised and drained. Incision should be made as soon as fluctuation is detected, for it will not recede, and adequate drainage will save weeks of delayed convalescence. The incision must be long, because the opening in a scrotum, after the inflammatory material has been released, becomes surprisingly small.

In the cases of the aged and in certain selected cases time and much suffering may be saved by performing an orchidectomy when fluctuation is detected instead of incising, for following drainage the discharge and slough often persist for weeks and even months, whereas, if the whole mass, testicle and epididymis, together with the purulent material, is removed, primary union will result, and a most trying and debilitating wound be avoided. This procedure was followed in the case cited here.



## TIME OF FINAL OPERATION

Patients who have been prepared for prostatectomy by many months of suprapubic drainage are exceptionally good risks, and may be safely operated on when the urea contents of the blood is higher, and the phenolsulphonephthalein return lower than is safe for patients not so prepared. Thus in this case the urea was 60 and the phenolsulphonephthalein return 20 per cent at the time the prostatectomy was performed, values that would contraindicate a primary operation. During 1922 no deaths occurred in the Urologic Service in the Clinic following the two-stage operation, although these patients represented the poorer surgical risks.

## HYPERTROPHY OF THE PROSTATE

E. STARR JUDD

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I WILL present six cases illustrating different types of hypertrophy of the prostate, and the problems to be considered in treating this condition.

**Case I. Adenomatous hypertrophy with marked cystitis.**—This patient, a farmer, sixty-four years of age, was operated on in 1920 by W. J. Mayo for cholecystitis with stones. About five years ago his urinary difficulty began with frequency and a slow stream. He was up from three to five times at night. Recently he had had more trouble, and the stream tended to be cut off. There was no blood in the urine, and he had not used a catheter. He had had no colics. His general condition had been good since the gallbladder operation, and his weight normal. The condition was diagnosed by Dr. Brasach as hypertrophy of the prostate, with considerable bilateral enlargement. The gland was soft and encapsulated, and there were moderate symptoms of obstruction. The patient had 3 ounces of residual urine, but his combined phenolsulphonephthalein test was 30 per cent, and his blood urea 28 mg. for each 100 c.c. Acute retention followed the taking of the cystogram October 1, which revealed a trabeculated bladder outline with elongation of the dome, typical of prostatic hypertrophy. The patient was put in the Colonial Hospital for preparatory treatment, which consisted of insertion of a permanent urethral catheter, irrigations of the bladder, and the forcing of liquids. He was kept on this régime for fourteen days, and then sent to St. Mary's Hospital. The operative diagnosis was adenofibromatous hypertrophy of the prostate. Suprapubic cystotomy was performed October 15. We use the suprapubic route almost exclusively; the exceptions are so few that I might say we

never use the perineal route. We prefer the suprapubic method because it is more of a surgical procedure, permitting good exposure, greater accuracy in technic, and certainty of a good functional result. With the perineal route, the functional result is uncertain, for although there may be no actual incontinence, the urgency is so marked as to amount to incontinence. With the suprapubic route I have never seen more than 1 ounce of residual urine after operation; with the perineal method, there may be 2 or 3 ounces. This proves that by the suprapubic route the bladder empties more satisfactorily. Moreover, enlargement of the prostate occurs within the internal sphincter in almost every case. If the suprapubic route is used, no matter how large the prostate is, the external sphincter will be pushed away from the line of resection. If the perineal route is used, the external sphincter is directly encountered. One of the objections to the suprapubic method is that the operative field is much more likely to become infected. This was true some years ago, but is no longer, because of improved asepsis and preparative precautions.

In this case, on opening the bladder, marked cystitis was found. The urethra was very much thickened, and standing up straight at the base of the bladder. The prostate was considerably enlarged, and covered with a thick congested mucous membrane. I enucleated the gland and packed the capsule with one strip of iodoform gauze, which I prefer to the rubber bag. A catheter was placed in the bladder, and a piece of tube in the suprapubic space.<sup>1</sup> The pathologist's report was adenofibromatous hypertrophy of the prostate.

**Case II. Adenofibromatous hypertrophy.**—This man, sixty-nine years of age, was operated on six days ago. His wound is in as good condition as after any abdominal operation. Five or six years ago he began to note nocturia and some frequency. Four years ago he began to have difficulty in micturition. In July, 1922, he became unable to void, and was catheterized,

<sup>1</sup> The patient was discharged on the twenty-ninth day, with the wound healed. He was voiding normally.

two quarts of urine being withdrawn; later the same night another quart was withdrawn. In April, 1923, he was again catheterized, one quart being withdrawn. He was not catheterized again before coming to the Clinic when he was urinating small amounts four to six times a day, and three to four times at night, but the stream often stopped abruptly. He was quite active and doing some farming. A cystogram, taken September 29, revealed marked trabeculation of the bladder, with no evidence of elevation or of reflux. The urologist's diagnosis was benign hypertrophy of the prostate, with 6 to 10 ounces of residual urine. The patient returned home to receive regular catheterization, and was advised to return soon for prostatectomy. On returning home he became quite ill with inflammation of the bladder. As soon as this subsided he returned to the Clinic, and after receiving preoperative treatment was operated on under regional anesthesia, November 1. At this time his blood urea was 28 mg. for each 100 c.c.

We use transsacral anesthesia in practically all of these cases, in order to get the patient up almost at once. The technic is simple: 30 c.c. of 1 per cent novocain solution containing 10 minims of adrenalin for each 100 c.c. are injected through the sacral hiatus into the sacral canal, and from 4 to 7 c.c. of the same solution through each of the sacral foramina. In addition a field block of the suprapubic region, using 0.5 per cent novocain solution containing 10 minims of adrenalin in 100 c.c., is made.

At operation bilateral enlargement 2+ and intravesical hypertrophy 1 of the prostate were found; the bladder was considerably trabeculated, with congestion and infection. The gland enucleated easily, and the capsule was sutured and packed lightly with gauze. In making the incision a very small opening was accidentally made in the peritoneum; this was closed immediately. The peritoneum was closed before the bladder was opened.

The pathologist reported benign adenofibromatous hypertrophy. It is now two weeks since the operation, and the patient is recovering uneventfully.

Case III. Benign hypertrophy with prostatitis, and calcareous deposits in the prostatic tissue.—This man, sixty-five years of age, was given a clinical diagnosis of pyuria with somewhat diminished phenolsulphonephthalein excretion. The prostate was definitely infected. There was a distinct history of gallbladder disease, but operation was not considered. The patient was referred to the Section on Urology, and the urologist's diagnosis following cystoscopy was intravesical hypertrophy 2 of the median lobe, bilateral 2, and chronic prostatitis. There was no residual urine. The phenolsulphonephthalein return was 25 per cent and the blood urea 34 mg for each 100 c c. The median lobe of the prostate was causing a variable amount of obstruction, but further medical treatment did not seem warranted.

I performed a suprapubic cystostomy October 31, and found the bladder to be thick walled, dilated, and moderately infected. There was adenohypertrophy and prostatitis, with some calcareous deposits in the prostatic tissue. The gland was enucleated with comparative ease. The capsule was sutured and packed lightly with iodoform gauze. One tube was placed in the bladder, and a split tube in the space. The pathologist's report was adenofibromatous hypertrophy.

This case is unusual because of the postoperative hemorrhage. Besides the stitches in the capsule we still use the gauze pack to control immediate bleeding. The bleeding that we are not always able to control comes later. This patient had a hemorrhage following removal of part of the gauze pack five days after operation. The patient was given a transfusion of 500 c c. of blood by the sodium citrate method. He had a chill a few minutes after the transfusion, but no further reaction. He continued to bleed, and was then taken to the operating room. On opening the bladder it was found to contain many large clots. The capsule was repacked with iodoform gauze, and the patient had no further trouble.

Bleeding after prostatectomy is a very serious complication. Bleeding at the time of the operation has been reduced materially by changes in the technic, and there is now practically no loss

of blood at this time. This was true in this case; the bladder was so dry that possibly we did not pay enough attention to the fact that bleeding might occur later. The same precautions should be taken in every case, whether the capsule seems dry or not. It is our custom to suture the prostatic capsule, since we believe that the fine catgut stitches, which remain in place for from ten days to two weeks, will help to control any bleeding that may occur during this time. A light gauze pack is used to control any oozing during the first twenty-four hours. Formerly we believed that, if these patients, many of whom have a hypertension, lost a little blood it would not be serious, and undoubtedly from the standpoint of circulation alone, the bleeding would not have been a consideration. We now believe, however, that nothing lowers resistance to infection more than anemia, and so long as all of these patients are more or less infected, it is most important that their resistance to infection be kept up as much as possible.

**Case IV. Prostatic hypertrophy with prostatic calculi, bilateral pyelonephritis, and cystitis.**—This patient is sixty-three years of age, and his condition represents the prostatitis of advancing years. In 1909 he had stones in the kidney, and now he has stones in the prostate. A stone in the kidney is made up largely of urates, but a stone in the prostate is composed of carbonates. In 1909 he was operated on for supposed tuberculosis of the right kidney. No tuberculosis was found, but a branched stone, 2.5 cm. long, in the pelvis, extending up into the lowest calyx, and a very small stone in the cortex were removed by a right pelviolithotomy. He returned to the Clinic in July, 1923, because of increasing frequency and slight incontinence. This symptom had been noticed prior to the first operation, and continued after it. The frequency was accompanied by burning and tenesmus, and was very marked (twenty times a day and twice at night). It was made worse by work. The patient passed a very small amount of urine at a time, and complained of having had soreness and rawness in the perineal region.

His general health was good, although his teeth and gums were in poor condition, and his tonsils submerged and infected.

Bilateral pyelonephritis with a small amount of pus was found. The function was normal. Shadows were present in the right renal area, but they were suspected to be calcified areas following the former operation, and not thought to denote a surgical condition. The prostate was boggy and enlarged 2, and was thought to contain stones, although none was felt. The x-ray revealed a large shadow over the prostatic area. The urine obtained from the right and left ureters contained no acid-fast bacilli. It was decided to clean up infection and then consider prostatic surgery later.

September 19, 1923, the condition of the bladder had greatly improved under irrigation. The patient was instructed how to wash his own bladder, and sent home, being advised to return if he did not get along well. He returned October 6, and at that time the prostate was definitely enlarged, firm, and smooth. A diagnosis of prostatitis with calcareous stones and severe cystitis was made.

October 22 a suprapubic cystostomy for partial prostatectomy was performed. The operative findings were: cystitis 3, pus in the urine, trabeculation 2, a thick bladder wall, and a congested mucous membrane. The prostate was not greatly enlarged, but there was definite prostatitis with a good many stones in the prostate. I broke into the prostatic tissue and removed about twenty-five stones, the largest being about 1 cm in diameter. I then performed a partial prostatectomy. The condition was evidently prostatitis with calcareous deposits. There is a tendency for such a condition to recur, so that it is advisable to take out as much prostate as possible. A few stitches were placed in the edge of the prostatic capsule, and the cavity packed lightly with gauze.

This case represents the type of prostatitis which develops in older persons. Most such cases have been treated by massage and hot sitz baths. Stones occur in the prostate gland under two distinct conditions: (1) Stones may occur in association with prostatitis, forming on some organic matter in the acini

of the gland. These stones are composed largely of carbonates and are not in any way connected with the urinary tract. They occur in cases of extreme prostatitis. Sometimes, with the urethroscope, they may be seen projecting from small openings in the prostate. The diagnosis is made by palpation with the finger. The hard feel of the gland due to stones is distinguished from that of cancer by the occurrence of a distinct crepitation in the presence of stones. However, if the calcareous deposits are marked, it is difficult to distinguish between prostatitis and cancer of the prostate gland. The x-ray usually reveals the stones. Stones are sometimes found in the prostate gland in association with adenomatous hypertrophy, but they are small and black, usually more like sandy particles than stone, and usually occur in the line of cleavage when the prostate is being enucleated. Sometimes they occur in considerable quantity, in which event they should be sponged out after the hypertrophied gland has been enucleated. These deposits must be the result of the inflammatory reaction in the prostate, but the condition is different from that found in association with marked prostatitis with stones in the acini.

**Case V. Benign hypertrophy with stones in a diverticulum of the bladder.**—This patient, a well preserved man of seventy-five years, began to have difficulty of micturition twenty-one years ago. The physician who was called catheterized the patient, who since then has used the catheter himself, usually three or four times a day, and as often at night. His general health has always been good. Three times in the last five or six years he has infected himself quite severely, and twice passed considerable bloody urine. Soreness of the bladder developed. Following the last infection, three weeks ago, the bladder became very sore, and the penis quite swollen. The patient had to spend part of the time in bed for several days. October 25, 1923, when he came to the Clinic, he felt well except for the soreness in the bladder, and he was sleeping well.

On rectal palpation, it was found that the prostate was



slightly irregular and enlarged 3. The x-ray examination revealed a large shadow in the bladder, probably a stone. The urine contained a moderate amount of pus. The phenolsulphonephthalein return was 50 per cent, and the blood urea 25 mg. for each 100 c.c. The urologist's diagnosis was benign hypertrophy of the prostate and diverticulum of the bladder, which contained a large stone, and primary prostatectomy with removal of the stone was advised. The position of the shadow of the stone in the roentgenogram, high and lateral in the bladder area, also indicated that it was in a diverticulum

When I saw the patient it seemed advisable to perform suprapubic cystotomy, and to remove the stone and prostate at the same time. I considered the risk 2. I found a very thick walled bladder with marked infection and trabeculation. There was a diverticulum in the base of the bladder, opening on the left side and posteriorly, containing pus, necrotic tissue, and a stone 2 cm. in diameter. I broke the stone in removing it, but believe that all was removed, as I could feel no fragments. There was marked intravesical and moderate bilateral enlargement of the prostate. The bladder and diverticular sac were drained, and a partial prostatectomy was performed. The gland enucleated easily, with only slight bleeding. The capsule was sutured and packed with iodoform gauze. The diverticulum was also packed with gauze. A strip of dark gauze was placed in the capsule, and a strip of light colored gauze in the diverticulum, to facilitate identification at the time of removal. The gauze in the capsule was loosened on the third day and removed on the fourth. The gauze in the diverticulum was loosened on the seventh day and removed on the eighth. The suprapubic tube was changed for the first time on the fourth day to a slightly smaller one, and thereafter as the sinus decreased in caliber a smaller tube was substituted. A urethral catheter was inserted on the twelfth day. The piece of rubber tube in the space of Retzius was removed on the fourth day.

The risk for this patient was increased by his age and by the marked infection present at the time of operation, but he is recovering uneventfully. The case is unusual because of the

long-continued use of a catheter, and the very good general condition of the patient, considering his age.

**Case VI. Prostatic hypertrophy with two(?) diverticula, stone in the bladder and stone in the diverticulum.**—A Mexican, sixty-eight years of age, was examined at the Clinic October 13, 1923. He had had no symptoms referable to the genito-urinary tract until about eight months before. After drinking rather heavily, he was unable to pass urine, and had to be catheterized three times before he could urinate freely. Since then he has experienced some burning during and after urination, amounting at times to real pain. This sensation seemed to be mainly in the urethra. He has noticed blood in the urine only once after catheterization. He has had slight tenesmus. He urinated about once in two hours during the day, and twice at night, usually toward morning. During the two weeks prior to this examination he has had pain in the left lower chest, which was worse on coughing, or taking a deep breath.

The abdomen was tender in the right lower quadrant. General arteriosclerosis was noted.  $\alpha$ -Ray of the kidneys, ureters, and bladder showed two stones in the bladder area. A cystogram revealed a small irregular bladder outline, including both original shadows with reflux of both ureters. The urologist's diagnosis was moderate prostatic hypertrophy with apparently no residual urine; chronic diffuse cystitis; two stones, 4 by 4 cm. and 1.5 by 1.5 cm., probably in separate diverticula (one stone may migrate into the bladder); bilateral dilated ureters, probably secondary to bilateral pyelonephritis and urethritis. The phenolsulphonephthalein return was 40 per cent and the blood urea 26 mg. for each 100 c.c. Suprapubic cystostomy was advised for removal of stones and diverticula, and examination of the prostate.

The diagnosis was benign hypertrophy of the prostate, marked cystitis, and multiple stones in the bladder. The risk was considered 2. October 22, suprapubic cystostomy was performed under local anesthesia. A large stone was found in

the bladder and a small one in the diverticulum, in the middle line, behind

I could not feel the stone in the diverticulum, but it was found after the neck of the diverticulum had been dilated. The prostate was found to be considerably hypertrophied, but drainage of the bladder with a No. 30 catheter and removal of the stones were all that seemed advisable to attempt at this stage. The patient was carefully prepared for the enucleation of the prostate, which was performed November 8. The suprapubic sinus was dilated, and the adenomatous gland enucleated easily. A strip of gauze was placed in the capsule, a tube in the bladder, and a piece of rubber tube in the space. The pathologist's report was adenofibromatous hypertrophy associated with chronic prostatitis, the capsule containing masses of putty-like material. The patient recovered uneventfully.

#### PATHOLOGY

From the standpoint of histopathology these prostates represent various stages of hypertrophy and infection, all of a benign nature. In some cases the enlargement is marked, and predominantly adenomatous, while in others fibrous tissue is in excess of glandular hypertrophy. Irritation and destruction occur in varying amounts, and the tissues react accordingly. Microscopic examination of the larger irregular, nodular prostates revealed marked hyperplasia of the adenomatous units and an increase in the amount of fibrous tissue and smooth muscle supporting the glandular acini. Cases of the extreme medullary type are usually the largest. Case III exemplifies nature's attempt to repair which is often seen in chronic infections, namely, the deposit of calcium in the tissues. The mineral salt is laid down in the tissues and around the débris in the obstructed and cystic ducts. In Case IV there is a definite calculus formation. The prostates in these cases may feel stony hard, irregular, and nodular on rectal examination, and suggest carcinoma. In the last four cases cited there is, besides the benign adenomatous hypertrophy of the glands, diffuse chronic prostatitis which, in some instances, results in small fibrous prostates,

quite shriveled, without great increase in size, although capable of definitely obstructing the outflow of urine. Not infrequently putty-like material can be squeezed from prostates, the seat of a long-standing prostatitis. This material is a collection of secretion and decomposing epithelial débris retained because of obstruction to the prostatic gland ducts. The hypertrophy and hyperplasia of the different tissues which form the enlargement in these prostates is shown under the high power of the microscope, best seen under the oil immersion lens. There is a complete differentiation of all cells involved, so that the processes are readily seen to be benign.



# THE OPERATIVE TREATMENT OF VESICOVAGINAL FISTULAS

CHARLES H. MAYO AND WALTMAN WALTERS

AMONG the many methods described as suitable for the repair of vesicovaginal fistulas of every size and location, the vaginal operation stands out as the method of choice. The success of

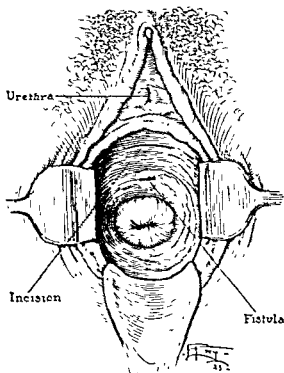


Fig. 103.—Horizontal incision through the wall of the vagina down to the musculature of the wall of the bladder. The incision is 7 mm above the fistula.

this operation depends not alone on the accurate closure of the openings in the walls of the bladder and vagina, but on the healing that occurs in the lines of suture. This, of course, has been recognized, and various methods to assist in healing have

been employed, such as suturing the openings at right angles to each other, as suggested by Kelly, Judd, Kretschmer, and others, and suturing the openings in the bladder and the vagina in different planes, as suggested by Ward. The latter we believe to be an exceedingly important procedure in the technic of operation on vesicovaginal fistulas. Just as the omentum forms a patch over an intestinal suture line, intact vaginal wall forms a patch over the suture line in the bladder. With this in view

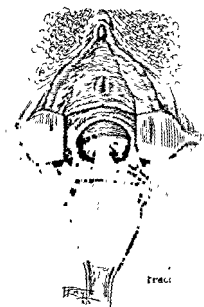


Fig. 109.—A horizontal incision through the vaginal mucosa about 7 mm above the fistulous opening, and the vaginal mucosa dissected to the fistula

one of us (Mayo) has adopted during the past year a method of repair of small vesicovaginal fistulas which has proved entirely satisfactory.

A transverse incision is made through the vaginal wall midway between the fistulous opening and the urethra, extending down to the wall of the bladder (Fig. 108). The part of the wall of the vagina which contains the fistula is dissected free from the wall of the bladder down to the fistulous tract (Fig. 109).

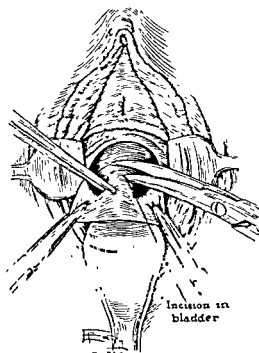


Fig. 110.—Incision into the bladder, and a circular dissection of the fistulous opening in the bladder.

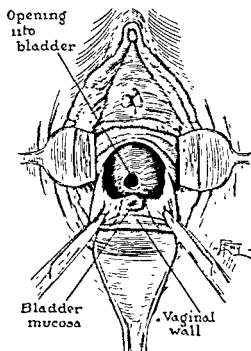


Fig. 111.—Opening in the wall of the vagina after the fistulous part of the bladder has been dissected out and left attached to the wall.



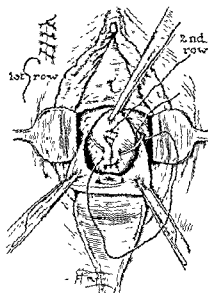


Fig. 112.—Closure of the opening in the bladder by two rows of vertical sutures

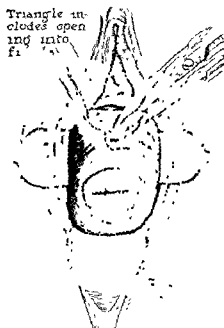


Fig. 113.—Removal of triangular portion of the wall of the vagina which includes the fistulous tract

The bladder is then incised at the periphery of the fistula, and a circular dissection made of the fistulous opening in the bladder (Fig. 110). This leaves the fistulous part of the bladder attached to the wall of the vagina (Fig. 111). The opening in the bladder is closed by two rows of sutures placed vertically, as shown in Figure 112. By removing a triangular portion of the vaginal

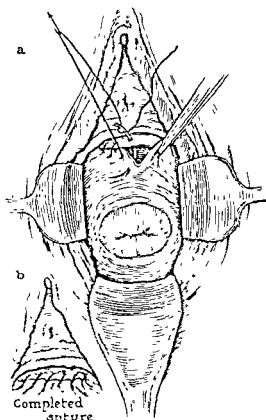


Fig. 114.—Horizontal closure of incision in the wall of the vagina, approximating the lower edge of the wall from which a wedge has been removed to the upper edge of the primary incision.

wall, which includes the fistulous tract (Fig. 113), it is possible to close the incision horizontally in the wall of the vagina, approximating its lower edge, from which the wedge has been removed, to the upper edge of the primary incision (Fig. 114). In this manner the intact unsutured wall of the vagina forms a patch over the suture line in the bladder.

The usual postoperative procedures are employed, such as

the insertion of a Pezzer self-retaining catheter through the urethra into the bladder; this is allowed to remain for five days, when it is removed, cleaned, and reinserted, and allowed to remain four more days. During the first week the patient is urged to lie on her abdomen

#### DISCUSSION

Hayward performed the first successful operation on a vesicovaginal fistula in this country in 1839, and directed attention to the necessity of separating the bladder from the wall of the vagina preliminary to the closure of such fistulas, this is undoubtedly the most important factor for success in the technic of the operation. He also described the method of downward displacement of the bladder and fistula by means of a bougie introduced into the bladder through the urethra and brought back to the fistula. Eight years later Mattauer reported his method of repair, using lead suture material. Marcy mentions the interesting fact that in a seven-year period Mattauer did not have a single failure following his operations. Sims in his celebrated case published in 1852 obtained a cure after four years of repeated failures on the same patient. Following this Mackenrodt and Jobert reported successful cases.

During the last two decades, Kelly, MacKenzie, Ward, Judd, C. H. Mayo, and others have recorded valuable technical procedures, which have become factors of success in the surgical treatment of vesicovaginal fistulas. Kelly suggests a transverse incision in the wall of the vagina opening into the peritoneal cavity, allowing the taut tissues to be set free. He then dissects the bladder free from the wall of the vagina, and closes the openings in the bladder and vagina separately, and at right angles to each other.

MacKenzie and Judd, after dissecting the wall of the vagina from the wall of the bladder, remove the fistulous tract and close the openings separately, without incising the peritoneal cavity. Judd also places the two lines of suture at right angles to each other.

One of Mayo's methods consists in dissecting the vaginal

mucosa toward the fistulous opening by means of an incision extending completely around the fistula. This leaves a funnel-shaped opening lined with mucous membrane which is connected with the mucosa of the bladder and projects into the vagina. By means of a ligature carrier passed through the urethra into the bladder and through the fistula into the vagina, two sutures are run through both walls of the funneled mucosa and attached to the ligature carrier, which when drawn from the bladder and urethra, causes the fistulous tract to invert into the bladder. Circular sutures are applied to the walls of the bladder and vagina, closing both openings.

When the fistula is too large to approximate its edges, Dowman has made use of the uterus to bridge the gap, tilting it forward so that the anterior wall of the uterus occupies the opening in the wall of the bladder, using a combined vaginal and abdominal approach, the abdominal incision being made to swing the uterus forward into position after the round ligaments, the fallopian tubes, and the utero-ovarian ligaments have been removed.

Cauterization of the smaller fistulas is often all that is necessary, according to Caulk, who uses high-frequency cauterization through the cystoscope. Rubright was able to assist the closure of a small vesicovaginal fistula in a child eight years of age by removing a hair pin from the bladder through a urethroscope, and touching the fistulous tract with 50 per cent silver nitrate.

As we have noted, the prevalent opinion appears to favor the vaginal approach in operating on such fistulas, since it carries less risk to the patient. The difficulties due to a small vagina can be overcome by episiotomy incisions, or by the paravaginal incisions of Schuchardt, for, as Kelly says, "success in difficult cases must depend on good exposure and easy accessibility."

The suprapubic transvesical method of approach has not been without advocates; Paris and Francey are prominently identified with this method. Trendelenburg, Marcy, and Legnen advocate the transperitoneal route, while Schulze and Berge prefer an approach through the prevesical space.

There is, we believe, a definite indication for the suprapubic

abdominal incision if the fistula involves one ureter. According to Kretschmer, a distinction can be made between vesicovaginal and ureterovaginal fistulas, either by ureteral catheterization, or by placing an argyrol solution in the bladder. If the fistula is ureterovaginal, the colored solution remains in the bladder. This brings up the point that before operating on any type of vesicovaginal fistula a cystoscopic examination should be made, and the relation of the ureteric openings to the fistula ascertained. Kretschmer believes that intravesical complications should be corrected at this time. Should the fistula be in close relationship to the ureter, necessitating the suprapubic transvesical approach, it is quite convenient to remember that the ureter runs transversely through the wall of the bladder. Cullen asserts that the ureter can be slit up one-half inch, thus allowing safe closure of the fistula.

The sources of difficulty in the vaginal approach to a vesicovaginal fistula are its distance from the exterior, and the proximity of scar tissue, making denudation and suturing awkward, and the tissues less ready to heal when approximated. The paravaginal incision of Schuchardt, or the lateral episiotomy incisions, have done much toward making these fistulas more accessible.

## A STUDY OF HISTOLOGY AND MORTALITY IN RENAL TUMORS

GORDON S. FOULDS, ALBERT J. SCHOLL, AND WILLIAM F. BRAASCH

BETWEEN January 1, 1901 and January 1, 1923, 283 patients with tumor of the kidney were operated on in the Mayo Clinic. These tumors are classified as follows:

Carcinoma . . . . .	243
Papillary adenocarcinoma (hypernephroma)	199
Alveolar carcinoma . . . . .	44
Malignant tumors in children	14
Sarcoma . . . . .	7
Benign tumors (adenoma, lipoma, and angioma).	3
Tumors of the renal pelvis (papillary and squamous-cell) . .	16

Nephrectomy was performed in 234 of the 283 cases; forty-three cases of carcinoma, five of tumor in children, and one of sarcoma were explored and found to be inoperable.

The postoperative data concerning the 234 nephrectomized patients were correlated with the pathologic data in an endeavor to determine the mortality rate accompanying the various types of growth.

### CARCINOMA OF THE KIDNEY

The carcinomas of the kidney were grouped according to Ewing's classification of malignant tumors of the renal epithelium into two main groups, papillary adenocarcinomas and alveolar carcinomas. Nephrectomy was performed in 200 of the 243 cases, of which complete pathologic data were obtainable in 184.

**Papillary adenocarcinomas.**—These tumors, usually considered as the hypernephroma group, are the most common of renal tumors. As a rule they are of only a moderate degree of malignancy, not infrequently existing for years without causing

symptoms. They generally form large, bulky, hemorrhagic and cystic tumors which cause marked distortion of the renal contour. They occurred in 152 (82.5 per cent) of the 184. Thirteen (8.5 per cent) of the patients died following operation,

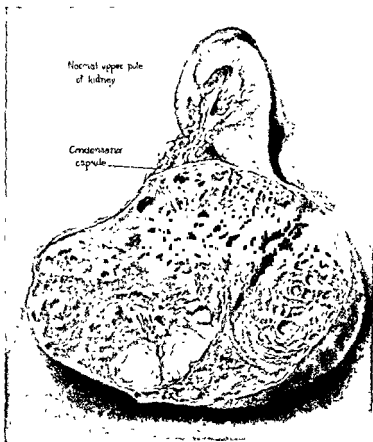


Fig. 115—Cystic, hemorrhagic, degenerating, well-encapsulated carcinoma of the lower pole of the kidney

twenty-three were not traced after operation and fifty-seven (53.8 per cent) of the remaining 106 are living and well, on an average of six years after operation.

The tumors are further divided into three groups: (1) papillary carcinomas with clear cells, (2) papillary carcinomas with

granular cells, and (3) malignant cystadenomas. The tumors of each division have a definite and individual histologic structure and a definite corresponding postoperative course.

Papillary carcinoma with clear cells are the most common of the carcinoma group. They form circumscribed yellowish or brownish-yellow tumors usually composed of small nodules separated from one another by fine bands of connective tissue. They are vascular, and similar to adenomas of the thyroid; areas of hemorrhagic, cystic, and hyaline degeneration are not uncommon (Fig. 115). The tumors extend by continuity,



Fig 116.—Flake-like clear cells of papillary adenocarcinoma of the kidney ( $\times 100$ ).

destroying the renal parenchyma, filling the pelvis, and at times growing into the renal veins. Histologically they are composed of a stroma or meshwork of capillaries surrounded by one or more layers of extremely large clear epithelial cells with deeply staining, rounded nuclei. The cells are usually polygonal and flake-like in appearance, not infrequently being finely reticulated. The whole structure is generally markedly papillary in formation (Figs. 116, 117). Ten (9.17 per cent) of the 109 patients with tumors of this type died following operation. Sixteen were not traced. Forty-two (50.5 per cent) of the re-



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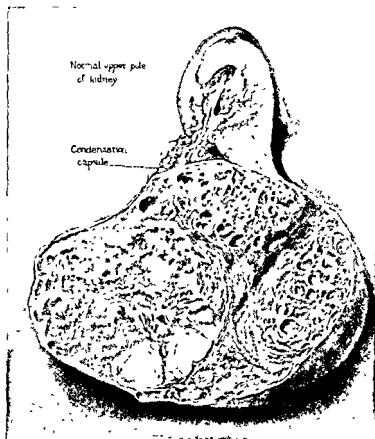


Fig 115—Cystic, hemorrhagic, degenerating, well-encapsulated carcinoma of the lower pole of the kidney

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The tumors are further divided into three groups: (1) papillary carcinomas with clear cells, (2) papillary carcinomas with

ally multiple, but usually single, and seldom contain hemorrhagic or cystic areas. They are generally smaller in size, of a more homogeneous texture, and show a greater tendency to infiltration and involvement of the renal pelvis than the clear cell tumors. Encapsulation is not a prominent feature with these tumors. Histologically they vary from a distinct papillary structure with lightly staining granular cells to an alveolar form which is composed of small, deeply staining granular cells (Figs. 118, 119). There were thirty-one patients in this group. Three (9.6 per cent) died following operation; six were not traced.



Fig 119 —Alveolar adenocarcinoma, with tendency to reproduce cells of adult kidney ( $\times 100$ ).

Only seven (31.9 per cent) of the remaining twenty-two patients are alive at present, on an average of eight and one-half years after operation (Fig. 120).

Malignant cystadenomas are rare, of a low degree of malignancy, cause few symptoms, are generally freely movable, and in most cases easily removed. They may appear as single or multiple growths, usually single. Although they may grow very large, in the majority of cases they involve only a small area of the kidney (Fig. 121). They are whitish in appearance, well encapsulated by thick bands of fibrous tissue which may

contain areas of hyalinization, secondary condensation capsules; the walling off of areas of extension not infrequently occurs. Histologically these tumors present a distinct cord-like papillary formation with bands of fine connective tissue, covered with a single layer of flat, deeply staining cuboidal cells. There were no operative deaths in the twelve cases of this series. One



Fig 120—Small carcinoma of the central portion of the kidney with normal renal pelvis.

patient was not traced. Eight (72.7 per cent) of the remaining eleven patients were well on an average of seven and one-half years after operation.

**Alveolar adenocarcinomas.**—Ewing considers the adenocarcinomas of infants, the embryonal adenocarcinomas of adults, and the tubular adenocarcinomas under this heading. In our

series no embryonal tumors of adults were found; the adenocarcinomas of infants are included under tumors of the kidney in children.

Alveolar carcinomas form only a small proportion of renal tumors. They are homogeneous and whitish in structure, and at times diffusely infiltrate the renal tissues. They are highly

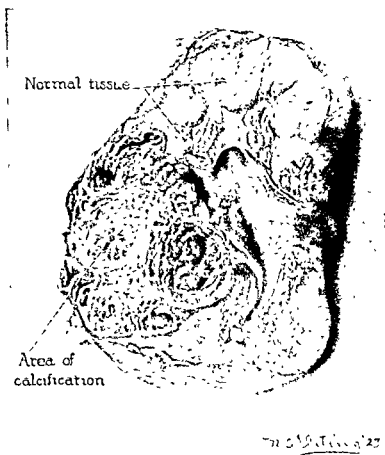


Fig. 121.—Localized papillary adenocarcinoma with fibrosis, hyalinization, and areas of calcification

malignant, early invading the pelvis and breaking through the renal capsule. Hemorrhage and cyst formation are rare. Histologically these tumors tend to reproduce the tubules of the adult kidney, resembling the renal parenchyma. The structure varies from that of well formed alveoli to areas in which there is very little differentiation, the cells being matted together with

only a small amount of intervening stroma. There were thirty-two cases of alveolar carcinoma in the series. Five (15.6 per cent) of the patients died following operation. Four patients

TABLE 1

HISTOLOGIC DATA IN RELATION TO POSTOPERATIVE COURSE IN 184 CASES OF CARCINOMA OF THE KIDNEY

	Patients		Hospital mortality		Patients	Dead		Living		Average post-operative life, months	Not traced
						Average length of symptoms, months	Average post-operative life, months	Patients	Average length of symptoms, months		
Papillary adenocarcinoma											
1. Papillary carcinoma with clear cells	109	59 23	10	9 17	41	18 81	29 28	42	53 01	60 54	16
2. Papillary adenocarcinoma with granular cells	31	16 84	3	9 67	15	21 53	17 23	7	19 00	99 14	6
3. Malignant papillary cystadenoma	12	6 52			3	17 00	9 50	8	29 25	89 0	1
Alveolar carcinoma	32	17 38	5	15 62	20	27 97	15 95	3	11 33	121 33	4

were not traced, and only three (13.4 per cent) of the remaining twenty-three are still alive; these three are living on an average of ten years after nephrectomy (Table 1)

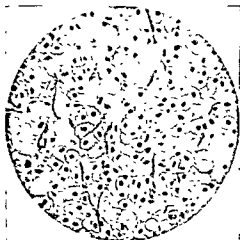


Fig 122.—Tumor of adrenal type, composed of broad masses of cells ( $\times 100$ ).

The term "hypernephroma" is still widely employed in clinical work, especially in reports from German clinics. It

implies a group of tumors of a moderate degree of malignancy, with a well recognized and definite clinical syndrome; despite its misadoption it will very probably continue to be widely used as a clinical term. There is unquestionably a definite, though small group of tumors, having a distinctive histologic structure, which occur in the kidney and are probably of adrenal origin. They generally form well encapsulated, solid, yellowish areas, with a histologic structure described by Ewing as "broad sheets of cells without alveolar formation" (Fig. 122).

### TUMORS OF THE KIDNEY IN CHILDREN

The majority of cases occur in the first two years of life. The tumors cause few symptoms. The pelvis of the kidney is generally not involved; consequently, hematuria and urinary obstruction are uncommon, and pain rare. Hematuria, when present, is not infrequently the only symptom. It is generally of short duration and may result from trauma. In the early stages the tumors are small, firm, freely movable, localized to the region of the kidney, and painless (Fig. 123). When moderately large, the mass often retains the contour of a normal kidney. Frazer asserts that a nodular irregularity suggests an increased growth of the more malignant portions of the tumor, and offers the patient a poor prognosis. The larger tumors are lobulated and cystic, at times filling the entire abdomen (Fig. 124). They may grow rapidly, the increase in size being due to intrarenal hemorrhage and cyst formation. The duration of symptoms is usually short before death occurs. Walker, in a series of unoperated cases, found the average period of life after the onset of symptoms to be eight months; following nephrectomy the average period of life was sixteen months. In an occasional case the period of symptoms and growth of the tumors extends for several years.

The tumors are generally confined by the renal capsule. They may occur in any part of the kidney and generally involve the entire organ, although at times apparently normal appendages of renal tissue are found. On cut section the kidney is irregular, lobulated, and presents several grossly contrasting

areas of tumor formation. The bulk of the tumor is whitish and homogeneous in texture

The tumor has a characteristic histologic structure. Many varieties of tissue have been described, but the predominating

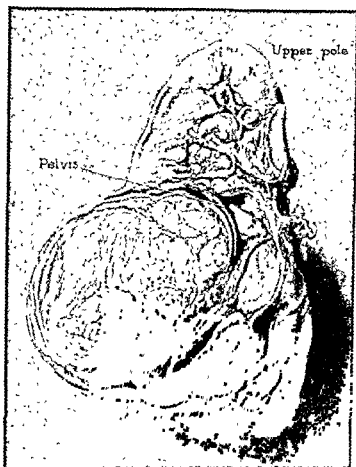


Fig. 123 —Carcinoma of the lower pole of the kidney with extension to the renal pelvis

structures are groups of incompletely formed glands, surrounded by masses of irregularly disposed cells of an appearance somewhat similar to that of the cells forming the glands (Fig 125). They may contain striated muscle, squamous-cell nests, and more

rarely areas of bone and cartilage. Magoun and MacCarty believe that the growth is composed of one type of cell in various stages of differentiation and with varying amounts of connective tissue reaction. They classify the tumors as carcinomas of the adenomatous type

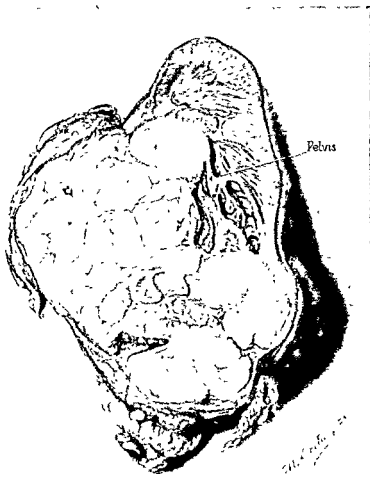


Fig. 124.—Almost complete destruction of the kidney by a mixed tumor (Wilms).

Metastasis is uncommon, and generally in the late stages. If metastasis or local extension has occurred, operation is often followed by a rapidly fatal outcome.

Death is certain if no operative interference is carried out. Nephrectomy in most cases prolongs life and offers the patient



the only chance of improvement. The earlier writers all agree on the very high mortality. Newer methods of surgical approach, improved asepsis, and at times avoidance of the peritoneal cavity, have in most instances greatly reduced the older mortality figures, but definite cures are few.

There were fourteen cases of renal tumor occurring in childhood in our series. The average age was thirty-six months. Nephrectomy was performed in nine, and exploration only in five. There was no operative mortality. In the five cases in



Fig. 125.—Mixed tumor of childhood. Note irregularly disposed cells and gland formation.

which only an exploration was performed, the kidney was examined transperitoneally. One child died three months after operation; the other four could not be traced. In the nine operable cases the renal mass was removed transperitoneally in seven, and extraperitoneally, through a posterior lateral incision, in two. Late reports were obtainable from seven of the nine patients. One is alive and well two years after operation, the remaining six are dead, one, four months, two, eight months, two, twelve months, and one, eighteen months after nephrectomy.

## SARCOMA

The study of sarcomas of the kidney is even more confusing than that of epithelial tumors; they are a small, ill-defined group, generally of questionable origin and structure, and are rare. They are at times confused with perirenal, retroperitoneal, and renal capsular tumors. Moreover, many renal carcinomas have areas which are not histologically dissimilar to sarcomas. Very few definite cases of sarcoma of the kidney have been reported. The term "sarcoma" is often used clinically to indicate the renal tumors of infancy. Many of these so-called sarcomas in children belong to the group of mixed tumors of childhood.

The point of origin of sarcomatous tumors occurring in the renal area is at times difficult to determine. Secondary deposits of lymphosarcoma may be found. There is also a group of sarcomas which develop in the renal capsule or pelvis, or in the region of the insertion of the renal vessels. These tumors may extend to the kidney, into the renal pelvis, or they may remain entirely extrarenal, spreading to the regional lymph glands and forming a large mass adjacent to the spine.

There are unquestionably a few renal tumors that are definitely sarcomas. They generally occur during early adult life; sometimes the symptoms begin suddenly and are rapidly fatal. A rapid increase in the size of the tumor is generally noted. As in carcinoma, this increase in size may be due to the formation and distention of cysts. Occasionally, the renal tumor is a large, tense abdominal mass. In some cases the growth is small, well localized, and does not invade the surrounding renal tissue.

There are seven cases in this series. The average age of the patients was thirty-one and six-tenths years. One case was inoperable, and nephrectomy was performed in the remaining six. There was no operative mortality. In the case in which an inoperable tumor was found, there was metastasis to the liver. This patient died one year after operation. Two of the six patients on whom a nephrectomy was performed had extremely large and cystic tumors which were removed transperitoneally. The tumors were removed by the lumbar, extra-

peritoneal route from the remaining four patients. There were two patients with spindle-cell sarcomas; both recovered readily from operation. No further data were obtainable. Two patients had mixed cell tumors, one died two years later from metastasis to the liver, the other could not be traced. In the fifth a small round-cell sarcoma occurred in a huge pyonephrotic kidney; the patient died three months after operation. The sixth patient had a large fibrosarcoma, and died one year after operation.

#### BENIGN TUMORS OF THE RENAL PARENCHYMA

Small adenomas and fibromas of the kidney are common. They may be single or multiple, they rarely increase in size, and are generally encapsulated. In most cases they are situated just beneath the renal capsule and probably result from chronic infective processes. Small lipomas are rarer. Occasionally these benign tumors become very large, either retaining their benign characteristics or becoming malignant. They rarely extend into the parenchyma, and destruction of renal tissue, when it occurs, results from pressure atrophy.

Large benign adenomas are rare; there was only one in this series. The patient, a woman, aged forty-eight years, came to the Clinic on account of a sudden severe hematuria. At operation the left kidney was found to contain a huge encapsulated tumor, 12 cm. in diameter, and was removed. Histologic examination of the tumor revealed a benign adenoma. Nine years later the patient was perfectly well.

There was one case of large lipoma in this series. The patient, a woman aged forty-nine years, complained of a general disability of twenty-six years' duration. Five years before, she had noticed an abdominal tumor which was accompanied by diarrhea and gastric disturbances. The urine was negative. A large, soft, irregular mass was found filling the abdomen. At operation a large left kidney, 20 cm. in diameter, was removed through a left rectus, transperitoneal incision. The patient's operative recovery was uneventful, and four years later she was in perfect health. Histologically the tumor was a simple lipoma.

Angiomas, similar to fibromas and lipomas, are generally small. The kidney is usually not enlarged. If the tumors involve the renal pelvis they may cause profuse hematuria.

There was one case of angioma in this series. The patient, a woman aged fifty-seven years, had been subject to recurrent attacks of hematuria associated with renal colic for thirty-seven years. The left kidney gave evidence of disease and was removed. A small angioma, 2 cm. in diameter, was found, which involved the upper pole and had eroded into the renal pelvis. Four years later the patient was perfectly well.

### TUMORS OF THE RENAL PELVIS

The renal pelvis is covered with transitional epithelium similar to the mucosa of the urinary bladder; consequently the histologic structure of tumors of the pelvis is very similar to that of tumors of the bladder; the majority are of epithelial origin and papillary in type. Squamous-cell tumors are more commonly found in the renal pelvis than in the bladder. Glandular types of malignancy are occasionally seen, but they are unusual and not infrequently are similar to tumors arising in the secretory portions of the kidney. Connective-tissue tumors are very rare; they are usually found in young persons and are highly malignant; occasionally they grow very large. Bilateral involvement is rare. Tumor growth is relatively more frequent in abnormally developed and poorly drained kidneys.

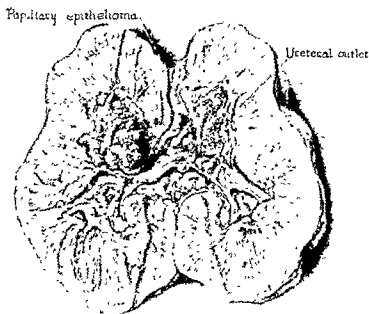
Sixteen cases of tumor of the renal pelvis occurred in this series. The average age of the patients was fifty-three years. Nephrectomy was performed in sixteen cases, with two deaths.

In fifteen cases the lumbar extraperitoneal route was employed. In one case the renal mass was cystic and very large; it was removed transperitoneally through a long rectus incision.

Ten of the sixteen cases were papillary tumors, and five were squamous cell; one was a diffuse carcinoma which was found in the pelvis of a huge pyonephrotic kidney, associated with multiple stones. Symptoms of renal stone had been present for forty years, and at the time of operation stones were also

present in the opposite kidney. The patient died three months after nephrectomy.

**Papillary tumors of the renal pelvis.**—These tumors grow slowly, cause a profuse hematuria and are generally accompanied by urinary infection, but rarely by stones. They extend readily to the ureter and bladder; consequently urinary obstruction,



*Th. 62a Fig. 23.*

Fig 126—Small, well-localized, papillary epithelioma, without destruction of renal tissue, and causing few symptoms

colic, and renal atrophy not infrequently occur (Fig. 126). The growth may vary in size from small localized villous tufts to extensive masses completely filling and distending the renal pelvis. When removed at operation the tumors are generally multiple and matted together. The pelvis at times is completely covered with the tumorous mass, which may also extend into and fill the dilated calices. As a rule the growth does not invade the

parenchymatous tissues. Papillary cyst adenomas arising in the solid portions of the kidney and invading the pelvis are, grossly, similar to papillary tumors of the pelvis. Cases of this type are often confused with pelvic tumors. Benign papillary tumors are rare. Careful histologic examinations will always reveal small areas which definitely indicate the malignant character of the growth.

There were ten cases of papillary tumor of the pelvis in this series. One patient died on the day of operation from postoperative hemorrhage. The growth extended along the renal vessels, and the renal vein was torn close to the vena cava during the removal of the mass. Material for histologic reëxamination was not available in this case. Of the remaining nine patients, three died from six to nine months after operation, and a fourth died four years after operation. Five patients are alive and well; two, six months; one, two years, and two, three years after operation.

**Squamous-cell carcinoma of the renal pelvis.**—These tumors are generally found associated with urinary infection and calculus formation. It is a painless, comparatively symptomless condition, and in most cases operation is performed only in the advanced stages. At times the formation of tumors is preceded by a long period of possibly premalignant symptoms. After becoming fully established, the disease has a tendency to recur readily after operation; metastasis is common, and operation in most cases has been rapidly fatal. In some cases the tumor spreads extensively in the renal pelvis, following which the ureteral outlet may become obstructed, converting the renal mass into a huge dilated sac. In most cases the pelvis is only moderately involved. It is thickened and fibrosed, and occasionally is filled with irregularly shaped stones and fatty tissue. The growth extends to and replaces the renal tissue. In these cases the kidney, which is only moderately enlarged and still retains its normal outline, is converted into a solid mass of carcinoma and fibrosis. Occasionally there is extension through the renal capsule, around the renal vessels and into the renal vein.

There were five cases of squamous-cell carcinoma of the renal pelvis in this series; in one case the tumor was confined to the pelvis. The mass, which was extremely large and cystic, was removed transperitoneally. The patient made a good post-operative recovery. Six months later no further symptoms had developed. The remaining four cases were of the type that involves not only the renal pelvis but also the parenchyma. The tumor in these cases was removed by the lumbar, extraperitoneal route. One patient died eight days after operation; the remaining patients died during the first four months.

# A REVIEW OF CASES OF HYDRONEPHROSIS AND PYONEPHROSIS

ALBERT J. SCHOLL AND E. STARR JUDD

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MANY hydronephroses are moderately infected, and on post-operative examination the kidneys are not unlike those considered clinically as pyonephrosis. In most cases the etiology, clinical course, and postoperative outlook are sufficiently different to warrant classifying the two conditions separately.

## HYDRONEPHROSIS

Symptoms of hydronephrosis generally appear in early adult life; the condition may be intermittent and extend over a period of many years. In most cases only one kidney is affected. Bilateral hydronephrosis when it occurs is generally associated with anomalies of the kidney or vascular tissue. The pelves of horseshoe kidneys are almost invariably dilated. Bilateral aberrant vessels may be associated with hydronephrosis; these are probably not causative, but at least increase the obstruction (Fig. 127).

From January 1, 1907 to January 1, 1923, 503 cases of hydronephrosis were treated surgically at the Mayo Clinic. In 475 the kidney was removed. In thirty-nine a plastic operation was performed, in eleven of which nephrectomy became necessary later. Complete postoperative data were obtainable in 436 cases.

## OPERATIVE PROCEDURES

An extraperitoneal lumbar nephrectomy through a posterior lateral incision was performed in 436 cases. This incision affords a sufficient exposure in practically all cases. In some instances in which the kidney is very large, removal is facilitated by first withdrawing the retained fluid. The sac may then be readily peeled out through a moderate sized incision. In cases of



slight or no infection, complications rarely arise if the kidney is drained or ruptured during removal. When the kidney is



Fig 127—Ureter kinked over a small anomalous vessel, which branched from the renal artery and supplied the lower pole of the kidney.

extremely large and it is desirable to remove it intact, enlarging the usual posterior lateral incision anteriorly and retracting the peritoneum toward the middle line will make the kidney

more accessible. Cutting the costovertebral ligament and the quadratus lumborum muscle when necessary also permits a more extensive operative exposure. Usually hydronephrotic kidneys which are not infected shell out readily. There are



Fig. 128.—Hydronephrosis limited to the pelvis, with only slight destruction of the kidney.

few adhesions, the vascular supply is greatly diminished, and there is but slight possibility of operative difficulty (Figs. 128, 129).

The pleura and the peritoneum are not infrequently torn or

opened, but in the absence of extensive infection this causes no trouble. The pleura was opened in six cases, and the peritoneum in twenty-six, without causing postoperative complications. In an occasional case, following opening of the pleura,



Fig. 129 —Dilatation and infection of the calices resulting from obstruction at the outlet of the pelvis.

roentgenographic examination of the chest will show an area of thickening at the base of the pleura, even though there are no symptoms. Many hydronephrotic kidneys have abnormal vascular connections, which must be looked for and ligated before they are cut or torn.

**Subcapsular nephrectomy.**—Scarring and perirenal adhesions from previous explorations or conservative operations on the kidney sometimes make it impossible to separate the kidney and its capsule from the surrounding tissues. Such operations had been performed in many cases of this group. In nineteen cases a renal stone had been removed, and in eleven cases a ureteral stone. Anomalous vessels had been cut in four cases, and a plastic operation performed on the ureteral outlet in four. In twelve cases the kidney had been drained, and in two a perinephritic abscess had been incised. In three cases a nephropexy had been performed.

Thirty of the 436 extraperitoneal nephrectomies were, of necessity, subcapsular. If an operation had previously been performed on the kidney, the incision for nephrectomy was generally made through the old scar down to the kidney. Usually the kidney separates readily from its capsule. The pedicle may be either clamped through the capsule, or the decapsulated kidney may be elevated and the capsule completely divided close to the sinus of the kidney and turned back over the pedicle. This makes it possible to pull the kidney and the vessels through the enveloping capsule, and to ligate the vessels directly. When the pedicle is clamped through the capsule the hemostatic forceps are generally left in place for seventy-two hours, no attempt being made to ligate the pedicle. There were no operative deaths following subcapsular nephrectomy, and in no instance was it necessary to remove the capsule later.

**Transperitoneal nephrectomy.**—The distended kidney may present as an abdominal tumor, especially in children, or it may be adherent to the under surface of the liver, to the diaphragm, or to the colon, making an anterior exploration essential. A transperitoneal nephrectomy was, therefore, performed in twenty-one cases. There were no postoperative deaths, and all the patients recovered. After the peritoneal cavity had been opened the posterior peritoneum was incised laterally to the ascending or hepatic colon on the right, and laterally to the descending colon on the left. In most cases the colon had been crowded markedly toward the middle line by the renal mass.

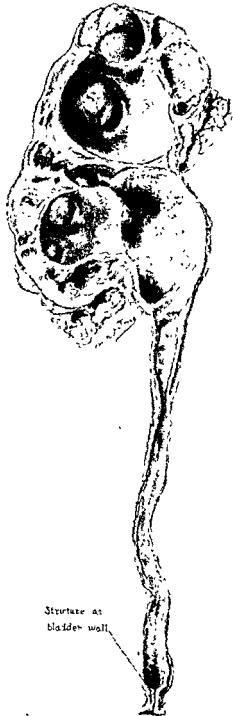


Fig. 130 —Hydronephrosis resulting from stricture of the lower ureter

In several cases an anterior transabdominal exploration was performed, and the kidney later removed through an extra-peritoneal lumbar incision. In infected cases free drainage is necessary, but in clean cases, with little hemorrhage and no soiling, drainage is unnecessary.

**Nephro-ureterectomy.**—Obstruction and extensive dilatation of the lower ureter, from stone, stricture, or previous operative procedures, may make it essential to remove the ureter completely. The possibility of contamination makes aseptic precautions particularly essential. A complete nephro-ureterectomy was performed in eighteen cases. There were no postoperative deaths. In most cases the kidney and upper ureter were entirely freed through a lumbar incision, the pedicle was ligated and cut, and the kidney left hanging by the ureter from the posterior angle of the wound. The patient was then turned on his back and an anterior rectus incision made. The remaining portion of the ureter was freed and ligated and cut with the cautery, at the ureterovesical juncture, and the kidney then retracted, drawing the ureter from the posterior wound (Fig. 130).

#### ILLUSTRATIVE CASES

**Case I.**—A woman, aged thirty-three years, had had attacks of right-sided colic and urinary frequency for four years. The urine was found to contain a large amount of pus. Roentgenograms revealed a shadow in the region of the lower right ureter. A stone corresponding in size and location to this shadow was palpated through the vagina. Cystoscopic examination revealed an obstruction of the right ureter, 2 cm. from the bladder, and a functionless right kidney. At operation through a posterior lateral incision, a large dilated kidney and ureter were found. The kidney was freed from adhesions, the vascular pedicle cut and ligated, the posterior wound closed, and two soft rubber drains inserted. The kidney was left hanging by the ureter from the anterior angle of the wound. The patient was then turned on her back and a low right rectus incision made. The peritoneum was retracted toward the middle line, and the lower right ureter exposed and freed down to the ureterovesical junc-

bladder. The peritoneum was retracted toward the middle line, and the kidney and ureter brought into the operative field. The vascular pedicle was clamped and the kidney completely freed. The muscles were then separated just above Poupart's ligament and the kidney forced down, and pulled through this lower opening with the ureter. The lower ureter was dissected out and, after ligation, cut with the cautery close to the bladder. A firm, almost impassable stricture was found in the lower ureter. Two rubber drains were drawn through the lower incision down to the bladder. The patient readily recovered from the operation and had no further trouble.

**Plastic operations.**—Plastic operations are now rarely performed, the frequency of infection as a sequela, the necessity for secondary nephrectomy, and the poor general results have discouraged most surgeons from using conservative procedures for hydronephrosis.

It is hoped that with increasing experience with these cases some plan can be worked out whereby it will be possible to save such slightly diseased kidneys. Removing a fairly normal-looking kidney because of a small hydronephrosis seems too radical, and yet if the hydronephrosis is the cause of repeated severe attacks of pain and possibly of increasing evidence of infection, it becomes necessary in order to afford a reasonable prospect of permanent relief. Plastic operations will relieve the obstruction which results from stricture or stones or aberrant vessels, but in many instances there is no demonstrable evidence of obstruction to the renal pelvis or ureter, and no other recognizable condition which would account for the trouble. Infection, or some change in the parenchyma of the kidney itself, must be a factor in the etiology of some cases of hydronephrosis, especially those of the interval type in which the renal pelvis is very slightly changed, if at all. Plastic operations were performed in thirty-nine cases in this series. With our present accurate functional tests the capacity of the opposite kidney is readily determined, and in the majority of cases, with even only moderate destruction of the kidney, nephrectomy is performed.

The plastic operation on ureterovesical outlet was performed in seven cases; two were satisfactory, and five were not. Peck's operation was performed in six cases; four were satisfactory, and two were not. Cutting of anomalous vessels was performed in seventeen cases; ten were satisfactory, and seven were not. Cutting of anomalous vessels and nephropexy was performed in nine cases; four were satisfactory, and five were not.

There were no operative deaths. Secondary nephrectomy was performed in four of the cases in which the plastic operation had been on the ureteropelvic outlet, in four of the cases in which anomalous vessels were cut, and in three in which nephropexy was performed. In the cases in which Peck's operation was carried out a ureteral catheter or malleable wire was inserted through the ureteropelvic juncture, passing out through the renal pelvis or cortex of the kidney to the skin incision. This was generally left in for several days. The patients who were relieved by the cutting of anomalous vessels are generally those whose symptoms were only moderate, and who had only slight and intermittent dilatation of the pelvis.

#### ASSOCIATED LESIONS

Anomalous vessels were found in sixty-five cases; it is questionable whether they are the primary cause of the hydronephrosis, or merely a secondary additional obstruction. Abnormal renal vessels are commonly found without evidence of hydronephrosis. Renal stones were found in forty-six cases. In the majority the stones were small, confined to the pelvis, and caused obstruction at the ureteropelvic outlet. In some cases the stones were small, multiple, round, and not impacted, possibly secondary to the hydronephrosis and infection. Ureteral stones were found in forty-three cases, usually in the lower third of the ureter, although frequently a short distance below the ureteropelvic juncture. In twenty-two cases a ureteral stricture was found; in a number of instances this was secondary either to the passage or removal of a ureteral stone. Other types of ureteral obstruction were found in nineteen cases. Tumors of the renal pelvis or renal parenchyma were found



in twelve cases. Papillary tumors of the pelvis readily cause obstruction either by extension of the growth to the uretero-pelvic juncture, or by transplants, generally to the lower ureter. In some cases extension to the pelvis by carcinoma of the renal parenchyma causes obstruction to the ureteral outlet resulting in a moderate hydronephrosis.

The abnormal course, kinking, and unusual insertion of the ureter in renal anomalies is a common cause of obstruction to

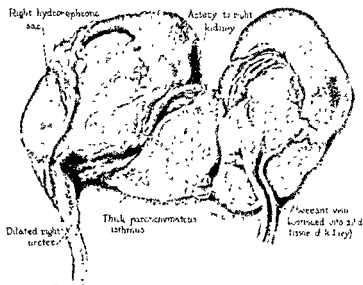


Fig. 132 —Bilateral hydronephrosis in a horseshoe kidney. The pelvis face anteriorly.

the renal pelvis (Fig. 132) This occurred in twenty-five cases in the series. Tuberculosis was found in three cases and a perirenal abscess in seven.

#### POSTOPERATIVE COURSE

The mistakes and accidents occurring during the evolution of urologic surgery are of interest in that they accentuate and magnify the complications and postoperative sequelæ of present-

day surgery. Early statistical reports are filled with the accidents now so rarely encountered that they are frequently unprovided for.

Five (1 per cent) of the 475 patients with primary nephrectomy in our series died following operation. Two died from hemorrhage the day of operation; both had large acutely infected kidneys, one kidney containing 4 liters of infected urine. In each case the retroperitoneal tissues were found at necropsy to be distended by a large hematoma. One boy of eleven had a large hydronephrotic half of a horseshoe kidney removed. The kidney had been operated on transperitoneally elsewhere, and was surrounded by tremendous adhesions. There was much bleeding during the operation, and moderate bleeding from the renal bed up to the time of his death on the seventh day. One patient died from general septicemia two days after an emergency operation for retention of the pyelographic medium. The opposite kidney contained multiple abscesses. The fifth patient died on the eleventh day from uremia.

Complete postoperative data were obtainable concerning 403 of the remaining 470 patients. Three hundred eighty-four (95 per cent) are living, nineteen (5 per cent) are dead. Thirty-seven are living from ten to fifteen years, 118 from five to ten years, 149 from two to five years, and eighty, one year after operation. Seven of the nineteen died during the first year, eight from two to five years after operation, and four from seven to ten years after.

Fourteen of 384 patients living have an infection in the remaining kidney; thirty-one complained of renal pain and discomfort. Only three have had further operations, one for the removal of ureteral stone, and two for the removal of renal stones; all operations were performed on the opposite side. The remaining 309 patients with complete data are in normal health.

### PYONEPHROSIS

In cases of pyonephrosis the element of infection is constantly present, which not only increases the postoperative morbidity and difficulty of operative technic, but is at times associated

It was necessary to free the tumor from the overlying descending colon before removal. The pedicle was clamped and tied, and the mass dissected out. There was much soiling during the operation, but the patient recovered, uneventfully, and left the hospital on the sixteenth day. Three years later she had had no further trouble.

*Comment.*—If well drained, the peritoneal cavity is surprisingly immune to renal infection. Following nephrectomy counterdrainage may be established through a lumbar incision and the peritoneal cavity closed, or the posterior layer may be closed, isolating the renal area which is drained through the lumbar muscles, and the peritoneal cavity drained anteriorly. If the renal mass is too large for removal, evacuation with a trocar is safer than the risk of rupturing the entire mass. If, on abdominal exploration, lumbar nephrectomy appears more advisable, the anterior incision may be closed, the patient turned on the side, and a lumbar nephrectomy carried out.

**Case VI.**—A man, aged thirty-eight years, came to the Clinic on account of an abdominal tumor of four months' duration. A diagnosis was made of large left abdominal tumor. At operation, through a left rectus incision, an enormous left pyonephrosis was found filling the entire left abdomen. The outer layer of the mesosigmoid was divided and 1,000 c.c. of pus aspirated from the mass. The renal sac, containing a stone which weighed 130 gm., was then removed. Counterdrainage through a lumbar incision was established, and the anterior layer of peritoneum closed. The peritoneal cavity was also drained anteriorly with two soft rubber drains. The patient recovered readily from the operation and had no further trouble.

**Drainage of the kidney.**—In a number of cases, because of adhesions and atrophy of the renal cortex, associated with extensive perirenal infection, it was impossible to determine whether the kidney itself had been opened or merely a perirenal abscess drained. Patients who had been operated on elsewhere generally reported merely that an abscess had been opened.

Not infrequently a perinephritic abscess communicated directly with the kidney; drainage of the abscess also indirectly drained the kidney.

In certain cases, in which the kidneys are too large to be removed intact, or in which nephrectomy would open an extensive area for infection, drainage permits the mass to shrink markedly, making a later nephrectomy much less hazardous. This procedure was carried out in seven of our cases. It is essential to keep the sinus open, as closure permits the kidney again to assume its former proportions, generally with symptoms of marked systemic infection.

#### ILLUSTRATIVE CASE

Case VII.—A man, aged thirty-eight years, had had chills and fever for three weeks with occasional attacks of sharp left-sided pain. The urine contained much pus, and there was a large soft fluctuating mass on the left side of the abdomen. The cystoscopic examination revealed the mass to be a left, functionless, dilated kidney. At operation a very large kidney was found filling the entire left abdomen. There was a marked thinning of the cortex; a trocar was inserted and six liters of fluid withdrawn. A rubber tube 1 cm. in diameter was sutured in the kidney. The patient made a good operative recovery. Four months later the renal mass had markedly decreased in size and was still draining pus and urine freely. One month later the fistula had closed, drainage had stopped, and the kidney increased to its previous dimension; the patient had severe chills and fever and had lost weight. The wound was opened to re-establish drainage, and again the mass decreased slightly in size. Two months later a subcapsular nephrectomy was performed. There was marked perinephritic infection and a localized abscess in the perirenal tissues. The ureter was not seen. Following operation the patient recovered readily and two months later was perfectly well, having had no further trouble.

## ASSOCIATED LESIONS

Lithiasis was the most common associated condition. Renal stones were found in 187 cases, and ureteral stones in thirty-

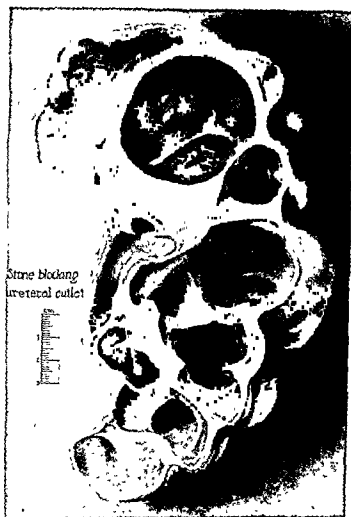


Fig. 133.—Completely destroyed infected kidney resulting from obstruction of the ureteropelvic outlet by a small stone

one (Fig. 133). Many of the patients with renal stones had been operated on, most of those not operated on had either

multiple or large stones, and had had a long preoperative period of symptoms. Usually the ureteral stones were single, and renal stones were not associated. In most cases the ureteral stones partially obstructed the ureter, causing atrophy from dilatation and infection. Pyonephrosis was due, in nine cases, to ureteral stricture which resulted from the passage, or surgical removal of ureteral stones, or other operative procedures. In several

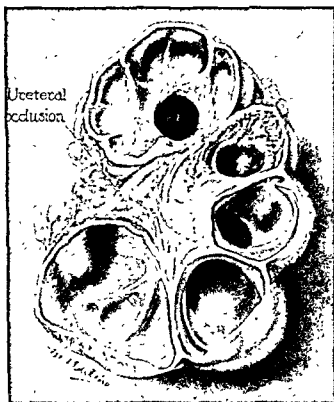


Fig. 134.—Occluded tuberculous pyonephrosis.

instances the stricture resulted from accidental trauma during the course of an abdominal operation.

Tuberculosis of the kidney was found in twenty-six cases. Many of these were of the occluded, completely destroyed type, only moderately infected. Rarely had previous operations been performed, and the majority of kidneys were removed without causing complications (Fig. 134).

Anomalous vessels were found in thirty cases. Unquestionably a much larger number were present, but wide-spread adhesions, extensive dilatation of the pelvis, and infection obscured the condition (Fig. 135). In two cases tumors of the kidney were found associated with the hydronephrosis. In one

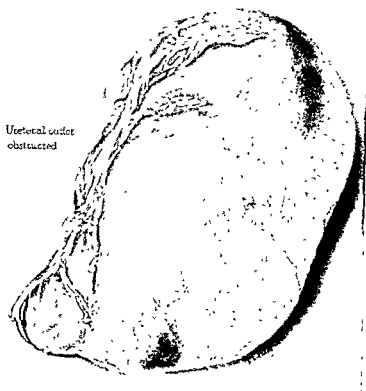


Fig 135.—Complete obstruction of the ureteropelvic outlet with destruction of the kidney.

of these the dilatation and infection were probably secondary to the tumor which grew into the pelvis from the renal parenchyma. In the second case the tumor, judging from its clinical course and histologic type, was probably secondary to stones, infection, and obstruction.

## ILLUSTRATIVE CASE

**Case VIII.**—A man, aged sixty-two years, came to the Clinic on account of a large cystic tumor in the right side of the abdomen. The mass was rounded, cystic, and painful on palpation. At operation, through a transperitoneal incision, the tumor was found to be irregular in shape and firmly adherent to the surrounding tissues. In freeing the adhesions the mass was ruptured; the remaining shell was then removed. The patient recovered readily from the operation and was in fair health when last heard from, six months after the operation. The pelvis was thickened and sacculated, and surfaced with many flat and papillomatous tumors, histologically squamous cell in structure. The kidney also contained multiple small calculi.

**Perinephritic abscess.**—This condition was a common accompaniment of pyonephrotic kidney. In most instances the kidney had either ruptured directly into the perirenal tissues, or a small abscess had broken through the renal capsule, which occurred most often if the kidney was completely destroyed and there was obstruction at the ureteropelvic juncture, or of the lower ureter from stone or stricture. In thirty-eight cases the perinephritic abscess was drained and nephrectomy performed several weeks or a number of years later. Almost invariably the wound continued to drain until the kidney was removed. There were no deaths in this series of thirty-eight cases. In twenty-five cases the perinephritic abscess was drained and the kidney removed at the same operation. Many of the patients were remarkably immune to infection; even with extensive soiling of the operative field they convalesced normally, and their wounds healed readily, as in cases of simple nephrectomy. There was one death following simultaneous nephrectomy and drainage of a perinephritic abscess.

## ILLUSTRATIVE CASES

**Case IX.**—A man, aged forty years, had had severe urethral infection and multiple peri-urethral abscesses for five years. There had been no renal symptoms, but on examination a large



mass was found in the right side of the abdomen. At operation a large, walled-off perinephritic abscess was found. The kidney, which was tuberculous and almost completely destroyed, was enucleated and the pedicle clamped. The abscess was curetted and drained. The curettage of the wall of the abscess produced an excessive hemorrhage, which was controlled by gauze packs. The clamps were taken off the pedicle and the gauze pack removed on the fifth day. This was followed by moderate hemorrhage and the cavity was repacked. The patient did not rally after the operation, and died on the nineteenth day.

If a patient with a destroyed infected kidney, and a perinephritic abscess is able to withstand nephrectomy, it should be performed. In many cases the patient may recover following simple drainage of the abscess, but the absorption from the destroyed infected kidney which frequently keeps the operative field saturated with infection may be a greater risk than primary nephrectomy. In certain cases stormy and fatal results may follow simple drainage.

**Case X.**—A man, aged forty-nine years, had had pain in the right loin for four years, more severe and constant recently. Examination revealed a fluctuating mass in the right lumbar region. At operation an extensive perinephritic inflammation was found. The tissues were too greatly indurated and the infection too severe to perform a nephrectomy, and the abscess was drained. The patient remained in good condition for several days, and then chills and fever developed and continued for thirty-six days, when the kidney was removed. Following this the convalescence was uneventful. In some instances the perinephritic infection may involve the neighboring organs or cavities of the body, not infrequently with a fatal outcome.

**Case XI.**—A man, aged twenty-four years, had had occasional attacks of severe pain in the right side of the abdomen for twelve years. He had frequent spells of bloating and vomiting, and was moderately constipated. Cystoscopic examination revealed a right pyonephrosis; 350 c.c. of moderately infected urine was

withdrawn from the right kidney. At operation a right hydronephrosis with a fistula in the right colon was found. The colon was separated and the fistula closed with silk sutures. The kidney, which was almost completely destroyed, was then removed. The wound was drained with one split rubber tube. The drain was removed on the ninth day, and the patient had convalesced uneventfully. Nine years later he had had no further trouble.

**Case XII.**—A woman, aged forty-four years, for eight months had been gradually growing weaker, and had noticed a mass in the right side of the abdomen. During the last six weeks she had had chills and fever. She was sick and cachectic, and on abdominal exploration it was found that a right abdominal mass was present with fluid in the general peritoneal cavity. At operation, through a right posterior lateral incision, a large pyonephrotic kidney was found which had ruptured into the peritoneal cavity. The kidney was removed and the incision freely drained. The patient died on the fourteenth day from peritonitis.

#### POSTOPERATIVE COURSE

Twelve (2.5 per cent) of our patients with primary nephrectomy for pyonephrosis died following operation. Two died from uremia and one died four days after operation from septicemia with multiple abscesses in the liver, spleen, and opposite kidney. One patient died the day of operation with bronchiectasis; the kidney, which was large, filled with pus, and obstructed, was removed as an emergency procedure. One patient died two days after operation from septic pneumonia and pericarditis. One died on the fourteenth day from thrombophlebitis of the inferior vena cava. In one case severe general hemorrhagic oozing occurred during the operation; this was controlled by gauze packing; on the fifth day the gauze was removed, and was followed by a second but milder hemorrhage. The patient died on the twelfth day; at necropsy a general miliary tuberculosis was found. Three patients died of peritonitis; in one case the renal mass had ruptured into the peritoneal

cavity before operation. In all cases the kidney was removed through a posterior lateral incision. Two patients died from duodenal fistula; one of these had pulmonary embolism following repair of the fistula eight days after nephrectomy; the second died eleven days after nephrectomy from pancreatitis and failure of nutrition.

Injury to the duodenum generally occurs in an attempt to clamp the vascular pedicle of the kidney. Grasping the bleeding vessels in the bottom of the wound with toothed forceps may also devitalize the tissues, so as to cause necrosis and fistula. Toothed forceps should not be used, and bleeding points should be controlled with a clamp held parallel to the wound.

Complete postoperative data were obtainable in 391 of the remaining 462 cases (388 nephrectomies and three nephrotomies). In two of the cases in which nephrotomy and drainage were performed the patients are still alive; one is in good general health, the second patient's opposite kidney is also diseased, which prevents further operative procedures on the pyonephrotic kidney. In both cases the wounds are draining. Nephrotomy was performed on the third patient as an emergency procedure, the opposite kidney being extensively diseased. He died shortly after operation.

Three hundred thirty-six (86.6 per cent) of 388 nephrectomized patients are alive, and fifty-two (13.4 per cent) are dead. One hundred thirty-three are living from five to twelve years, 163 from two to five years, and forty, one year after operation. Five patients have persisting sinuses which have been draining from two to five years; and one patient has a hernia in the operative wound. Thirty-four patients have had attacks of pain over the opposite kidney. Nineteen have infection of the kidney and bladder, and eighteen complain of frequency and dysuria. In two cases in which stones had been left at operation and ruptured through the kidney, they were removed from the perirenal tissues. In one case a ureteral stone which was left in place caused a painful persisting fistula; this was removed, with a good result. In four cases an abscess formed in the incision and required drainage, and in one case it was neces-

sary to remove the renal capsule which had been left following subcapsular nephrectomy. The sinus, which had persisted, healed after the second operation.

In certain cases a small sinus persists for a short time following nephrectomy, especially subcapsular nephrectomy, or if there has been extensive soiling of the operative field. Generally these fistulas respond readily to conservative operative measures, such as curettage or excision. A persistent sinus may result from retained portions of the kidney, or a thickened edematous capsule, from a stone which has escaped into the perirenal tissues, or is left with a portion of the renal pelvis. A ureteral stone blocking a dilated infected ureter may also cause drainage.



## OBSTRUCTIVE DYSPNEA FOLLOWING SURGERY OF THE THYROID AND ITS PREVENTION

JOHN DEJ. PEMBERTON

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OBSTRUCTIVE dyspnea may occur as an early or late complication following operation on the thyroid. As an early complication it may become manifest either during the course of the operation, or more frequently from six to twenty-four hours afterward. In most instances onset is gradual, beginning with a slight inspiratory stridor, steadily progressing until inspiratory movements are associated with marked muscular effort, the breathing becomes extremely noisy and the patient is manifestly in great distress. A definite cyanosis is usually present from the onset, and this deepens as the dyspnea becomes more marked. If the obstruction is not relieved (preferably by a tracheotomy), the dyspnea will become very suddenly worse, usually within six to twelve hours, and the general condition, alarming. Unless a tracheotomy is performed immediately the patient will die. Formerly it was customary to attribute all cases of postoperative dyspnea to one of two conditions: collapse of the trachea or edema of the glottis. Both were considered unavoidable complications, at least neither condition carried with it any suggestion of technical error in the performance of the operation. That there are instances in which the rings of the trachea have become softened by the long continued pressure of a large goiter, and in which, after the removal of the support of the goiter, the walls collapse, is well recognized, but the occurrence of this type of dyspnea is very infrequent, and probably responsible for less than 2 per cent of all cases of postoperative obstructive dyspnea. Likewise laryngeal edema is a frequent complication or sequela of thyroidectomy, but very seldom is it severe enough to produce marked dyspnea. On the other hand, the routine laryngeal examination of all patients with

goiter before and after operation, and the careful search for a traumatized recurrent laryngeal nerve in all cases of obstructive dyspnea coming to necropsy, has clearly demonstrated that the cause of fully 90 per cent of all cases of marked postoperative obstructive dyspnea is due to a paralysis of one or both vocal cords, the result of an injured inferior laryngeal nerve.

Permanent injury of the nerve, such as is inflicted by suturing, clamping, or severing, results in paralysis of the vocal cord, which is usually manifested by complete abductor paralysis, so that the cord lies in the middle line position, thereby narrowing the glottis. Occasionally, however, it is found in the intermediate or cadaveric position. There has been no satisfactory explanation to account for this difference. If only one nerve is injured and marked edema of the larynx does not supervene, only hoarseness will follow, with little or no difficulty in breathing. On the other hand, the combination of edema and the paralysis of only one cord will often result in severe obstructive dyspnea. Injury to both nerves usually is followed by early obstructive dyspnea. When the cords occupy the cadaveric position, the glottis is open and the patient experiences no difficulty in breathing, but because of the inability to approximate the cords, the voice is lost. In the latter group the voice always returns in from three to six months, but almost invariably accompanying the return of phonation, obstructive dyspnea develops, at first present only on exertion, but becoming progressively worse until the patient cannot breathe freely at any time. An examination of the larynx reveals that the cords are approximated with inability to abduct. Many hypotheses have been advanced to explain this change. New believes that it is the result of the compensatory action of the muscles of the larynx innervated by the superior laryngeal nerve.

It can be readily appreciated, then, that the effect of an injured nerve may be far more serious than the production of hoarseness, or temporary, or even permanent, loss of voice. A clinical study of patients whose inferior laryngeal nerves have been permanently injured makes it possible to classify the effects as follows:

1. Injury of one nerve, a change in voice being the only appreciable effect. This may vary from a very slight elevation in the pitch of the voice to a marked hoarseness. Such patients form the largest group, and often a change in the voice is not even realized by the patient or attendants, and the injury of the nerve is only recognized in the course of the routine laryngeal examination.

2. Injury of one or both nerves, resulting in postoperative obstructive dyspnea. This is always a serious complication, and may be the decisive or contributing factor in the death of the patient. Tracheotomy should be performed early, and after from three to six days the tube may be withdrawn without the return of the dyspnea.

3. Injury to both nerves resulting in the cords immediately occupying the cadaveric position with complete loss of voice. New has traced all the patients in this group, and almost invariably the voice has returned in from three to six months, with the accompanying development of dyspnea. The cords are now in abductor paralysis position (middle line position), and a varying degree of dyspnea is permanent. For its relief one of three procedures must be employed: (a) permanent tracheotomy with its obvious disadvantages; (b) ventriculo-cordectomy, that is, the removal of a portion of one vocal cord and part of the ventricle, with risk of loss of voice and with prospect of only partial relief of the obstruction, and (c) nerve anastomosis. Frazier has recently anastomosed the descending branch of the hypoglossal nerve to the inferior laryngeal nerve. Sufficient time has not yet elapsed to judge the results. We are hopeful that this procedure may afford relief from this most distressing complication.

During the progress of an operation for goiter the type of trauma to the nerve responsible for the permanent paralysis of the cord is, under ordinary conditions, limited to clamping, suturing, tying, or severing the nerve. Paralysis may result from stretching the nerve, as in the careless dislocation of the lobe, or from undue pressure of the finger against the nerve in attempting to control bleeding, but this is invariably of tem-



porary character, and probably never of more than a few hours' duration. A complication of this type is probably not of clinical significance, unless by chance it should occur to the sound nerve in a patient with one cord already permanently paralyzed. In such an instance obstructive breathing may occur while the patient is on the operating table, and possibly a tracheotomy will be necessary.

In the earlier days of thyroid surgery, when the routine procedure consisted in the complete removal of the lobe, the occurrence of disturbances incident to injury of the inferior laryngeal nerve and the parathyroid bodies was relatively common. This fact was early recognized by surgeons, especially Kocher, Mikulicz, Halsted, C. H. Mayo, and others, and in order to establish a buffer between the field of operation and these important structures which lie behind, the dictum of preserving the posterior capsule or the posterior part of the lobe was formulated. The practical application of this rule undoubtedly led to a great reduction in the incidence of nerve injuries, and has become recognized as a sound principle in thyroid surgery. However, the impression is held by not a few that if the posterior portion of the lobe is preserved, and the operator does not work behind the posterior capsule of the gland, the nerve will be safe from injury by direct trauma. The permanent injuries that have occurred when these rules have been observed have been attributed to the stretching of the nerve by careless dislocation of the lobe, or by the pressure of the assistant's finger behind the lobe. In reality, the injury is probably always the result of direct trauma, such as suturing, tying, clamping, or severing the nerve.

The details in the manner of avoiding injury to the nerve must of necessity vary with the type of goiter and with the individual method of the operator, but there are certain principles applicable to all cases, which become apparent when the anatomic relations of the nerve to the gland are considered. The opinion commonly expressed is that the nerve lies posterior to the lobe of the gland, and that by preserving the posterior part of the gland an effectual barrier is established between the operative

field and the nerve behind. In the normal sized gland this is true (Fig. 136) and the precaution in such instances is commonly effective in preventing injury to the nerve. However, in the enlargement of the gland, the growth often takes place in all directions, sometimes encircling the trachea and esophagus, and then the position of the nerve becomes posteromesial to the lobe (Fig. 137). In such cases it is apparent that if the lateral wall of the trachea is exposed, even though a large posterior portion of the lobe is preserved, the nerve will still be endangered. The angle between the lateral wall of the trachea and mesial

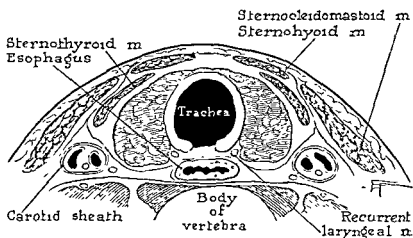


Fig. 136—Schematic drawing of cross-section of neck at level of the middle of the thyroid gland. Note the relation of the recurrent laryngeal nerve to the gland, and its posterior position in a normal thyroid gland

surface of the lobe must always be regarded as the dangerous angle, and it is through this approach that the nerve is frequently injured. The mesial branches of the inferior thyroid artery pass forward between the mesial border of the lobe and the trachea, and if in the resection of the lobe the lateral wall of the trachea is exposed, these branches will be severed in close proximity to the nerve and, in the control of bleeding, the nerve may readily be injured (Fig. 137). It is obvious, then, that two principles must always be kept in mind, (a) the preservation of the posteromesial portion of the lobe, and (b) the avoidance of exposing the lateral wall of the trachea.

While the foregoing principles may be adhered to in all of several methods of resecting the thyroid gland, I have adopted

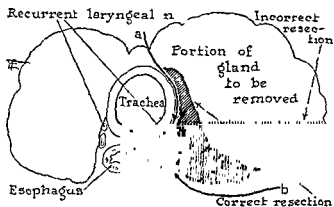


Fig 137 —Enlarged thyroid gland and cross-section of goiter. Note that the recurrent laryngeal nerve lies mesial to the lobe of the gland, and the relative ease with which the nerve may be injured if the lateral wall of the trachea is exposed b, The approach through which the nerve is commonly thought to be injured, a, the approach through which the nerve is in reality most frequently injured

the method of resecting the lobe from within out After exposing the gland, the middle thyroid veins are ligated and tied,

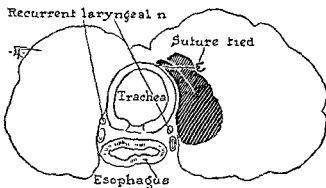


Fig 138 —Operation for resection of the right lobe completed Sutures are not placed posterior to the plane of the anterior border of the trachea.

the lobe is dislocated and the superior pole is clamped and divided. The suspensory ligament of the thyroid between the

larynx and the anteromesial border of the lobe is cut. The isthmus can readily be divided, exposing the anterior border of the trachea. Several clamps are placed along the mesial surface of the lobe, clamping where possible the mesial branches of the inferior thyroid artery, care being taken that the points of the clamps are not placed posterior to the frontal plane of the anterior border of the trachea. If resection of the lobe is now made from within out, anterior to the level of these clamps, leaving the posteromesial portion of the gland, injury to the nerve and parathyroid bodies is impossible. The remnant of the lobe may be sutured without fear of injuring the nerve, provided the sutures do not enter the mesial part of the gland behind the frontal plane of the anterior border of the trachea (Fig. 138).

In the last 2,500 thyroidectomies in the Clinic there has been but one instance of marked obstructive dyspnea. This occurred in a patient who had been operated on elsewhere for goiter, and preoperative examination of the larynx revealed fixation of the right cord in the middle line. During the progress of the operation for the resection of the left lobe, laryngeal obstruction suddenly developed and it was necessary to perform tracheotomy immediately. The patient recovered, and the tracheotomy tube was withdrawn within a week with no return of dyspnea. Postoperative laryngeal examination showed only the right cord paralyzed.

The practical elimination of this complication in surgery of the thyroid is attributable to the fact that the recognition of the influence played by an injured recurrent laryngeal nerve in the production of obstructive dyspnea has led to more detailed care in the application of the two principles of technic discussed.



## PARTIAL THYROIDECTOMY FOR EXOPHTHALMIC GOITER

WALTER E. SISTRUNK

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THIS patient, a woman aged thirty-five years, has been nervous and has had a goiter for five years. She came to the Clinic in 1919, when a diagnosis of exophthalmic goiter was made, but operation was refused. Since 1919 she has had trouble of varying intensity, tires easily on walking, and complains of slight swelling of the ankles. She has had no vomiting or diarrhea. The heart beats rapidly and pounds on exercise; the patient worries considerably, and is easily irritated and excited. She is about 10 pounds under normal weight. The thyroid gland, which is about three or four times normal size, is symmetrically enlarged and hard; the metabolic rate is +66, the pulse 123. The patient has now been in the hospital twelve days under observation, and during this time the metabolic rate has dropped to +25; the pulse rate varies from 80 to 100. She has gained 2 pounds since entering the hospital. Thyroidectomy will be performed today.

We obtain the best results in the treatment of exophthalmic goiter by partial thyroidectomy. When the operation is performed before the disease has produced marked changes in the vital organs and before exophthalmos has developed, the patients often improve sufficiently to be able to resume their full duties, and many show little evidence of having had exophthalmic goiter. The results in patients operated on after the disease has progressed further depend almost entirely on the amount of damage that has occurred at the time the operation is performed.

If the disease is allowed to run its natural course without treatment, in the majority of patients with exophthalmic goiter the disease has a gradual onset and tends to grow progressively

worse. The metabolic rate, which in the beginning is low, rises slowly, and the symptoms usually associated with exophthalmic goiter, such as rapid pulse, tremor, nervousness, loss of weight, and so forth, gradually increase. Many patients during the second six months of their illness develop a thyroid crisis, and marked degenerative changes occur in their vital organs.

If the condition is treated by means other than surgery, certain patients can be cured, but unfortunately during the early stages of the disease it is impossible to tell which cases will respond to such treatment. If no improvement follows the treatment, or should a relapse occur, the patient runs considerable chance of passing into a thyroid crisis. In such an event it is impossible to obtain, by any measures, the result which could have been promised had an operation been performed in the early stages of the disease.

In nearly all early cases the thyroid gland becomes slightly enlarged, firmer and harder than normal, and when true exophthalmic goiter is present, all show an increase in metabolic rate with the classical symptoms of exophthalmic goiter. When doubt exists as to the true diagnosis, the patient is usually placed in bed for a few days, and if, in spite of rest, the metabolic rate still remains above normal, the diagnosis of exophthalmic goiter can usually be made definitely. After this every effort is made to remove the gland before marked damage occurs in the vital organs. In the early stages it is often possible, after a short preliminary treatment, to perform a primary thyroidectomy; the operation may now be done with a smaller risk than at any other time.

We are able to prepare patients for operation more quickly through the administration of iodine than by any other known method. The patients are placed in a hospital for observation and are given from 15 to 30 minims of compound solution of iodine (Lugol's solution) in water or milk each day. The metabolic rate and weight are carefully noted two or three times a week. Lugol's solution produces a very marked and rapid improvement in the nervous symptoms, and usually causes a drop in the metabolic rate and pulse with a general improve-

ment in the condition of the patient within a very short time. Loss of weight usually stops under this treatment; in fact, the patient often begins to gain in weight rapidly.

The metabolic rate, when carefully taken, shows very accurately the degree of hyperthyroidism present, but cannot be used alone as a means of determining just when and what type of operation should be performed. It also is an excellent guide as to improvement from treatment. Generally, when patients are seen with early exophthalmic goiter, who have not lost much weight and who have ceased to lose weight at the time the operation is contemplated, and who have had a drop in the metabolic rate following treatment, they can have a primary thyroidectomy with a high degree of safety. The pulse rate in such cases is usually not above 110 or 115, and unless the nervous and mental symptoms are very marked, a primary thyroidectomy is usually performed. If a question exists, however, as to the safety of this procedure, a simple operation like a hot water injection or ligation is first used in order to determine the patient's reaction to any operative procedure. Reactions following simpler operations of this sort are very similar to those which follow thyroidectomy, but are much less severe in character. They usually come on from twenty-four to thirty-six hours after operation and consist in an increase in the pulse rate, fever, and nervousness. If the reaction is slight and other conditions seem favorable, a thyroidectomy can usually be performed within a week. If, however, the reaction is marked, it is safer to perform a second ligation after a week, and wait for two or three months before performing a thyroidectomy. During this time patients often gain from 10 to 30 pounds in weight, and although the metabolic rate may remain almost the same, the improvement considerably decreases the operative risk for thyroidectomy. It seldom happens that a patient who has been carefully prepared and selected for operation will develop an unexpected degree of hyperthyroidism after operation.

By such measures the mortality from thyroidectomies for exophthalmic goiter can be considerably lessened. The mor-



tality in this work, however, also depends to a certain extent on the skill with which the operation is performed. Thyroid surgery has advanced to such a stage that death on the operating table from hemorrhage or suffocation seldom occurs, and the mortality which can be traced to surgery is usually dependent on some postoperative complication, which occurs in an extremely sick patient. In bad surgical risks it is highly essential that no serious complication occur following the operation if the patient is to be given the best chance for recovery.

The dangerous complications which may occur are: (1) temporary or permanent injury to one or both of the recurrent laryngeal nerves, which often produces a postoperative obstructive dyspnea of such a degree that a tracheotomy becomes necessary; (2) postoperative hemorrhage, which also may so interfere with breathing that an emergency tracheotomy becomes necessary, (3) pneumonia, and (4) wound infections, with high fever

Too much emphasis cannot be placed on the injury which may occur to one or both of the recurrent laryngeal nerves. These injuries frequently go unrecognized, because the patient talks, and the difficulty in breathing in such cases is believed to be due to some tracheal disturbance. If the dyspnea is sufficient to produce cyanosis, unless an early tracheotomy is performed, the patient may die. Of course, the danger of tracheotomy shortly after a thyroidectomy increases greatly the chance of death

The danger of temporary or permanent nerve injury seems increased in patients with large, hard lobes lying partially underneath the trachea. The risk in such cases may be diminished by removing one lobe at a time, and after the patient has recovered sufficiently, performing a second operation for removal of the remaining lobe. Almost all patients whose condition permits lobectomy would stand a complete thyroidectomy without much added risk so far as hyperthyroidism is concerned, but lobectomy is safer because it diminishes the chance of serious postoperative complications. When one lobe only is removed, the length of operation is usually divided in half, and the chance

for secondary hemorrhage is also only half as great; if the nerve is injured on the side operated on, the chances are that serious dyspnea will not occur because the nerve on the opposite side has been left undisturbed.

Secondary hemorrhage fortunately is rare. It is probably best prevented by permitting patients to awaken sufficiently from the anesthetic to cough or strain thoroughly after all the vessels have been ligated, thus precipitating any serious bleeding which might develop later during vomiting. Pneumonia is probably best avoided by performing the operation either under local anesthesia, or a combined local and light general anesthesia produced by nitrous oxid or ethylene. Wound infection can be avoided by very careful antisepsis.

When patients are carefully selected for operation, after having been observed for from a few days to a week or longer in the hospital, and a type of operation chosen which will avoid serious postoperative complications, the mortality from thyroidectomy for exophthalmic goiter can be reduced to a point below 1 per cent. Through such procedures we have been able so to reduce our mortality that it is lower than that seen in patients being treated medically, and as the ultimate results from thyroidectomy have been so superior to those obtained by any non-surgical method, I believe that all patients with exophthalmic goiter should, when possible, be given the advantage of an early thyroidectomy.



## ANGINA PECTORIS AND SURGICAL DISEASES OF THE ABDOMEN

FREDRICK A. WILLIUS

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THE patient whom I bring before the clinic today is one who presents many interesting features from the standpoint of diagnosis. He is fifty-five years old. He came to the Clinic complaining of attacks of severe midepigastrie pain. The trouble began about six months ago, when he developed a severe, oppressive, nonradiating pain, high in the midepigastrium, occurring soon after a heavy meal. Temporary relief was afforded by the belching of gas. The pain was increased by walking, and the attack terminated in about one-half hour, after the patient had induced vomiting. Friends of the patient who had witnessed the attacks said that his face would become pallid, beads of perspiration stand out on his forehead, and his breathing become rapid. He felt fairly well the next day, except for being somewhat weak, and resumed his work as bookkeeper. His health previously had been excellent. The attacks recurred at irregular intervals. There was no history of indigestion between attacks when the patient ate discreetly. There had been no jaundice. The patient denied being short of breath on exertion, and further questioning revealed that his habits were extremely sedentary, and that the physical effort exerted in his daily routine work was very slight.

Examination disclosed findings of importance: The cardiac dulness extended 4 cm. to the right and 11 cm. to the left of the midsternal line. No murmurs were audible and the rhythm was normal. The heart tones were rather distant, but the normal differentiation of first and second tone was maintained. There was a moderate degree of arteriosclerosis of the peripheral arteries. The systolic blood pressure was

146, and the diastolic 86. The urinalysis was negative and the blood findings normal. The blood Wassermann reaction was negative. Roentgenologic examination of the chest revealed only slight enlargement of the heart to the left, the condition of the stomach, duodenum, and gallbladder was negative. Electrocardiography revealed a rate of 82, rhythm of sinus origin, T wave negativity in Derivation I, and preponderance of the left ventricle. A diagnosis of angina pectoris, with coronary sclerosis, was made.

### DISCUSSION

The initial interpretation of this history would at once direct attention to the abdomen, with consideration of the gallbladder first. The sudden onset of severe epigastric pain, induced by indiscretions in diet, very often is due to disease of the gallbladder. The pain experienced by this patient bears a quantitative and not a qualitative relationship to food, a point of considerable value in the analysis of the complaint, since gallbladder attacks so often are precipitated by the eating of certain foods, such as *fried or greasy foods, onions, and cabbage.*

An important point in the history is the onset of trouble after the fifty-fifth year in a man previously healthy. This time of life is notorious for the assertion of degenerative diseases, particularly of the heart, kidneys, and arteries. The fact, however, that this man's attacks always followed the ingestion of a large meal and that the history did not allude to the relationship of exertion in precipitating the attacks, seemed to exclude organic disease of the heart. The patient rarely exerted himself sufficiently to experience shortness of breath, yet his intermittent indiscretions in diet were sufficient to cause cardiac overload with the development of severe anginal attacks with atypical distribution of pain. It is very important to question and cross-question patients in middle life who present abdominal symptoms, for in each case the possibility of angina pectoris must be considered.

Physical examination in this case was of relatively little value,

as the slight enlargement of the heart to the left in a man of middle life is often of little significance. The electrocardiogram was extremely helpful, revealing the T wave in Derivation I to be negative, an abnormality only associated with myocardial disease. The coexistence of angina pectoris and surgical disease of the abdomen is not uncommon, about one-fourth of the patients with coronary sclerosis having disease of the gallbladder, and must always be given careful and thorough consideration before a diagnosis is made.

### DIFFERENTIAL DIAGNOSIS

Angina pectoris is a syndrome and not a disease, and may be due to one of several pathologic processes: (1) coronary sclerosis, (2) coronary embolism or thrombosis, (3) aortitis, syphilitic and nonsyphilitic, (4) aneurysm of the thoracic and abdominal aorta, (5) adhesive pericarditis, and (6) mitral stenosis, occasionally. There should be little difficulty in differentiating the types of angina pectoris enumerated, as the physical signs of the various pathologic processes are quite well defined and should be detected by careful physical examination, supplemented by the various laboratory methods. The careful elicitation and the critical analysis of the history is of paramount importance, particularly when the anginal syndrome is atypical. From the standpoint of pain, location, and distribution almost every painful surgical disease of the abdomen may be simulated.

One of the most common errors in diagnosis, and one of the most difficult differentiations, is in cases of coronary embolism or thrombosis. This condition is characterized by the extremely sudden onset of excruciating pain, usually behind the lower sternum or high in the midepigastrium, with variable and unreliable radiation. One of the most characteristic features of the pain is its persistence until death supervenes, or when the myocardial infarct is small and not vital, until the heart begins to recover from the severe insult. The patient is in profound shock, with pallid cyanosis, cold perspiration, clammy extremities, rapid, shallow respirations (later becoming of the Cheyne-

Stokes type), rapid, thready pulse, and the facies of extreme suffering. Physical examination soon after the onset of the accident may reveal only weak, rapid heart tones, the rhythm at times being interrupted by premature contractions. A few hours later a distinct pericardial rub is audible, usually to and fro in character, and heard best over the lower sternum. This rub is due to the inflammatory reaction of the visceral pericardium overlying the infarcted area. If the infarct is large the area of cardiac dullness will be found to increase, owing to the weakening of the muscle with the development of an out-pouching, or so-called cardiac aneurysm. The upper abdomen may be distinctly resistant and almost rigid on palpation, falsely pointing to disease of the upper abdomen. This is in part, at least, due to the splinting of the diaphragm, a protective mechanism resulting from the patient's attempt to reduce the excruciating pain.

Leukocytosis, as high as 15,000 to 25,000, usually occurs, and completely misleads the uninitiated observer. Fever, often attaining 100° to 102°, may be present within twenty-four hours. Electrocardiography is very helpful in identifying sudden occlusion of the coronaries, giving a record virtually pathognomonic. There is a tendency of fusion between the R and T waves and sudden high amplitude, and peaked inversions of the T waves also occur.

The symptoms of acute coronary occlusion are most often confused with the acute perforation of a gastric or duodenal ulcer, the rupture of a distended gallbladder, or with acute hemorrhagic pancreatitis.

## DIFFERENTIAL PROBLEMS AND TREATMENT OF NODULAR AND ULCERATIVE LESIONS OF THE SCALP AS ILLUSTRATED BY A CASE OF FIBROSARCOMA

JOHN H. STOKES

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NOT every tumor of the scalp is a sebaceous cyst. This seeming truism is one which deserves wide publicity. The differential diagnosis of nodular and ulcerative lesions of the scalp is complex and often involves extended study, and laboratory as well as clinical investigation. The case here described illustrates very well a number of the problems which a lesion of the scalp may present both from the standpoint of diagnosis and treatment.

A woman, aged twenty-nine years, came to the Clinic complaining of sores in the scalp and backache. The outstanding facts of the history of the condition of the scalp include a duration of four years, incision of the lesion by one physician three years ago, excision by a surgeon two years ago, with the diagnosis of sebaceous cyst, and recurrence, with the appearance of new lesions a few months later. Since the recurrence there has been occasional pain on pressure. The patient had been told that the excised lesion contained ingrown hairs and was an infected sebaceous cyst.

On general examination the patient was found to be overweight, to have mild hypertension, and repeatedly negative blood Wassermann reactions. Dermatologic consultation was called, and it was noted that the patient had a seborrheic dermatitis and an alopecia, secondary to scarring in the surgically treated area. The condition on the scalp of which the patient complained covered an area of perhaps 10 sq. cm. in the left frontal region about 2 cm. back of the hair line. It consisted of several nodules, one of which was inflamed and slightly fluctuating, the others firm and attached apparently to the skull. When





Fig. 139.—Fibrosarcoma of the scalp. Note the thickening and adhesion of the scalp to the skull at the point indicated by the arrow. This adhesion led to a suspicion of malignancy and repetition of a previously negative tissue examination.



Fig. 140.—Postoperative result. The alopecia is due to radium.

the hair was clipped away there seemed to be no definite configuration to the lesion, nothing to suggest an epithelioma, and a good deal of scaling accompanied by a peculiar odor somewhat suggestive of the "mousy" odor of favus of the scalp.

The diagnostic possibilities include:

(1) Favus of the scalp, (2) cicatrizing alopecia, (3) seborrheic dermatitis with secondary follicular infection and furun-



Fig. 141 —Gross specimen, showing the thin lamellar tumor on the under surface of the galea, adherent to the skull. A nodule is shown at A, thickness of the tumor at B.

culosis, (4) multiple sebaceous cysts, one of them infected, (5) nodular or nodulo-ulcerative syphilid, (6) tuberculosis, (7) sporotrichosis, (8) blastomycosis, (9) a malignant process, either epithelioma or sarcoma, (10) Kaposi endothelioma of the scalp, and (11) metastasis from a distant malignant lesion, such as hypernephroma.

Favus of the scalp, it is worth while to remember, is practically the only chronic ringworm of the scalp in adults. Occasionally cattle ringworms obtain a foothold in the scalp and produce a macaroon-like lesion known as *kerion celsi*. Favus may be suspected at times by the peculiar mousy odor of the scalp and can be recognized in the gross by the presence of the minute sulphur yellow cup-like collections of scales known as the favus scutuli. On the other hand, typical scutuli may be absent and only a dirty scaling may be recognized. Accordingly it is necessary to examine scales and scrapings from the scalp under 10 to 40 per cent potassium hydroxid for the detection of this ringworm even in adults, whenever a lesion of the scalp is causing permanent scarring with loss of hair. Cases of favus may be of extreme chronicity and may go unrecognized for many years. The scales in this case were repeatedly negative microscopically and culturally.

Cicatrizing alopecia of the scalp should be considered wherever there is a localized or a scattered loss of hair with permanent scarring. The essential lesion is a follicular pustule with the hair projecting through the yellow center. The individual hair is destroyed, but it is rare to see a secondary infection of the deeper layers of the scalp, or anything suggesting nodule or tumor formation.

Secondary follicular infection and furunculosis of the scalp is not uncommon at the back of the scalp in persons with a tendency to obesity, greasy skins and oily hair with dandruff (seborrheic dermatitis) on the scalp. The individual lesions are usually small pustules which subside without producing much reaction, but occasionally one finds furuncular lesions which run their usual course and are followed by satellites. A four-year history, as in this case, however, is rather unusual for a series of boils on any part of the body.

Multiple sebaceous cysts are usually more scattered than the lesions in this case and are nearly always cystic rather than nodular. On incision they discharge typical cheesy or semifluid yellowish contents, and if properly opened, a lining membrane can nearly always be extracted. If on cutting into

a supposed sebaceous cyst one finds a solid or semisolid tumor, he should be on guard. Moreover, when a lesion, originally solitary, is followed after incision by a group of two or three other similar lesions within a few centimeters distance, one's suspicions of a malignant or granulomatous process should at once be aroused. When one of the nodules finally appears on the forehead anterior to the hair line the possibility of sebaceous cyst is practically eliminated.

Nodular or nodulo-ulcerative syphilids may begin as small isolated tumors in the scalp, and especially on surgical interference are likely to be followed by diffuse infiltration of the scalp with the appearance of other nodules arranged in more or less characteristic arciform configurations. The recognition of late syphilids in the scalp is so much interfered with by the difficulty in seeing the configurations through the growth of hair that it is a practice with many dermatologists to insist on the shaving or close clipping of a considerable area of scalp surrounding a lesion, in order that the outline or distribution of the nodules or ulcerative lesions may be carefully studied. A negative blood Wassermann reaction, as in this case, does not necessarily exclude syphilis. Not infrequently in gummas of the scalp the original process is in the underlying bone, and an x-ray of the skull will show an area of osteitis or softening which, if not malignant in origin, is quite diagnostic of syphilis. In this case, while there was no definite arciform configuration to the lesion, some suspicion of syphilis persisted, and a provocative procedure and therapeutic test of one injection of arsphenamin and two months of inunctions were resorted to in the effort to clear up the problem.

Tuberculosis of the scalp is essentially a theoretic possibility, and is likely to be of the primary inoculation type with early metastasis to an adjacent lymph node. The diagnosis should be readily made from examination of excised tissue. Tuberculosis of the scalp must certainly be quite rare, and although I have seen cases at the hair margin, I have never seen an authentic example of involvement of the hairy scalp.

Sporotrichosis is, of course, rare in the scalp, but I have seen

it at the hair line produce a picture so puzzling that only routine culture of the purulent discharge established the identity of the lesion. Metastasis to a neighboring lymph node with suppuration is highly characteristic. Blastomycosis is likewise occasionally seen in the scalp producing a papillomatous lesion with a central atrophic and hairless scar. The papillomatous border is less apparent in the scalp than on the glabrous skin, and a biopsy taken from the margin is sometimes the only means of clinching the diagnosis.

Epithelioma of the squamous cell type may begin in a blastomycotic lesion, producing a nodular pearly border which slowly extends with or without central involution. In this case the nodules were not continuous with the original lesion, but appeared as scattered outgrowths, several of them so far from the parent lesion as fairly well to eliminate the possibility of squamous-cell epithelioma. It should be recalled that the epithelial hyperplasia of blastomycosis sometimes deceives the inexperienced into suspecting epithelioma, even in histologic section.

"Endothelioma capitis" is really an improper term for multiple basal cell epithelioma of the scalp which give rises to scattered tumors varying from the dimensions of a small flat wart to large nodules the size of a hazelnut, some of which may break down, forming typical ulcers with sharply defined elevated margins. The diagnosis must usually be made by examination of tissue.

Among the more remote possibilities one should always consider in all tumors or nodules of the scalp the possibility of malignant metastasis from a distant focus, and particularly from hypernephroma, which shows a distinct predilection for the skull and the ribs. The diagnosis can, of course, only be established by microscopic examination.

The diagnostic possibility to which, in this case we gave only the most delayed consideration, is that of sarcoma. Sarcomas of the scalp in my experience are rare, and fibrosarcomas of the type which this patient presents are among the rarest of malignant cutaneous lesions.

The diagnosis of fibrosarcoma in this case was led up to by

elimination, and then made by examination of tissue. At first I was inclined to believe that the lesions were a group of infected sebaceous cysts. Examination for a ringworm fungus had been negative, and nothing had been obtained culturally from the region. The next most obvious step was that of taking a specimen of tissue for examination, which resulted in the finding of nothing but chronic inflammatory changes by two laboratories. It is important to emphasize that failure of a biopsy to supply the basis for a correct diagnosis in skin lesions is frequently due, first, to the fact that the tissue is removed from an old or involuting or secondarily infected part of the original lesion, and second, to the fact that the operator does not cut deep enough to secure a picture of the process in its entirety. This is precisely what occurred in this case, with the resulting erroneous diagnosis of a chronic inflammatory process. With this negative finding so far as the granulomas and malignancy were concerned, we treated this patient with small doses of x-ray, wet dressings of potassium permanganate, and inunctions of ammoniated mercury ointment. The patient made a very definite favorable response and we believe the diagnosis established. Part of the favorable response was, of course, due to the effect of x-ray on the neoplasm.

The process did not, however, completely heal, and a syphilid was again suspected. The provocative test, with its single arsenamin injection, had not produced any local reaction (Herxheimer), nor any improvement in the lesion. Forty mercurial inunctions were likewise without effect. In fact, during this therapeutic test the lesion again began definitely to extend. On re-examination, when the patient was asked to wrinkle her eyebrows, it was noted that the scalp had become adherent to the skull on the left side of the forehead to within 3 cm. of the left eyebrow. There were no nodules throughout the adherent area and only a slight sense of thickening was noted near the hair line. This aroused my suspicion that some process had gained a foothold between the aponeurosis and the skull, in a way which is quite suggestive of syphilis or malignant change. Inasmuch as the therapeutic test had practically

eliminated syphilis, it remained to make a renewed search for a malignant lesion in spite of the negative findings on first examination. A second biopsy was performed, the tissue being taken well out from the old inflammatory area at a point where only slight thickening could be detected, and the operator was told to cut deep. On doing so, he found a sharply defined almost encapsulated plaque of tissue, beneath rather than in the scalp, a specimen from which on examination by Dr. Broders resulted in a diagnosis of *fibrosarcoma of a low grade of malignancy*.

Fibrosarcomas of the skin are, as I have said, quite rare. They are locally rather than generally malignant, in which respect they differ sharply from the other sarcomas of the skin which are usually highly malignant and metastasize rapidly. On the other hand, fibrosarcomas are usually diagnosed so late in the cases which I have seen that surgical intervention is difficult because the growth extends considerably beyond the visible lesion. In this case, fortunately, the lesion was sharply defined, easily accessible, and therefore particularly susceptible to surgical treatment. In those cases in which removal has been incomplete, ulcerative breakdown of the operative scar is the usual rule and extensive damage ultimately results. *x-Ray* or radium treatment, carefully guarded, should follow any operative removal.

The patient was operated on by Dr. Adson. A description of the operative treatment is as follows:

On making the incision an oval mass was found over the frontal bone, extending backward from the glabella, being most prominent over the middle area of the frontal bone; the mass was approximately 9 by 6 cm. with a long axis antero-posteriorly, and an average thickness of 5 mm. The skin was eroded in the region of a former incision in the middle line of this mass. In order to expose the mass it was necessary to make one longitudinal incision and two transverse incisions extending each way from the longitudinal incision, so that four flaps of the scalp could be reflected to expose this pancake-like tumor, which had its origin in the subdermal tissues of the scalp, with-

out becoming densely adherent either to the bone or to the epidermis, except for two or three small areas close to the former exploration which were excised with the tumor. After the mass was removed the skin flaps were sutured with interrupted stitches of silkworm-gut over the bone, without any underlying fibrous tissue. The tumor primarily arose from the galea, making it comparatively easy to remove the specimen. Post-operative care was that usually employed in clean surgical wounds.

The patient's progress was uneventful except for the development of a small skin defect in the frontoparietal region. To cover this defect a plastic closure was made with a satisfactory result. Radium was then applied, 11,698 mg. hours over the entire affected area. Following this treatment there was no unfavorable reaction, although a small superficial erosion developed over the site of plastic repair. This healed very promptly under local applications. The patient is still under observation.





## RADIODERMATITIS AND ITS TREATMENT

ARTHUR U. DESJARDINS AND FRED L. SMITH

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THE reaction of the skin to various irritating substances, while of the same general character, may vary somewhat according to the nature of the irritant, and it is sometimes possible to determine the type of the irritating agent by the reaction itself. Thus, the characteristic effect of certain chemical substances, such as phenol, is well known. The specific features of such reaction depend on the strength of the substance employed. Pure acids and alkalis destroy the integument before it has time to oppose any defense, but if the acid or alkali is suitably diluted, any degree of irritation and of consequent reaction can be produced. The only factor involved, besides the nature and strength of the irritating agent, is the resistance of the tissues as affected by their condition.

Many substances, quite innocuous or indeed stimulating under ordinary conditions, may readily produce more or less irritation, and even destruction, if the conditions under which they act are altered. The rays of the sun are a striking example. Exposure to the solar rays under judiciously controlled conditions not only is free from injurious effect, but frequently produces astonishing stimulation of growth or repair. However, as painful experiences have taught many of us, careless exposure to the sun can produce very definite and incontrovertible tissue irritation and, in extreme cases, actual destruction.

The effect of x-rays and of radium rays on the skin resembles in many ways that of the sun, but there are also certain outstanding points of difference. In both cases exposure beyond certain limits will cause the appearance of more or less pronounced evidences of irritation, from erythema to vesiculation, and finally to necrosis; in both, these evidences are confined to the surface directly exposed, and in both the appearance of the surface in corresponding degrees of irritation bears many points

of resemblance. Besides the degree of exposure required to produce irritation, such reaction depends in both cases on the complexion of the individual (degree of natural pigmentation), the part of the body (thickness of the skin or number of cell layers), and the metabolic state of the skin as affected by circulatory and nervous activity.

However, solar dermatitis and radiodermatitis differ much in reaction time. In the former reaction follows action within a few hours; in the latter reaction seldom appears before from five to twenty days (generally seven to fourteen). While a relatively thin layer of any material substance will provide adequate protection against the solar rays, such protection in the case of x-rays and radium rays requires a sufficient layer of material of high atomic weight, such as lead foil or sheet lead.

With the increased use of x-rays, both for diagnostic and therapeutic purposes, it is but natural that radiodermatitis should be more common. While improvements in technic and more accurate methods of measuring dosage have made it easier for the experienced radiologist to avoid extreme degrees of cutaneous irritation or destruction, instances of accidental "burns" continue to occur. In diagnostic radiology such accidents usually happen in the hands of the inexperienced. In treatment radiodermatitis is not so commonly "accidental." In treating many lesions, particularly the resistant types of malignancy, it is often necessary to give the maximal dose permissible, and, since the skin varies somewhat in sensitiveness, there is more or less marked local reaction in certain cases. There is also the possibility of technical errors, such as the incorrect measurement of distance, the omission of filters, with a technic requiring filtration, and inaccurate timing. Indeed, when severe forms of radiodermatitis are encountered, they are nearly always the result of such errors.

The determination of x-ray dosage (or exposure time in radioscopy and radiography) is based on the following factors: effective voltage at the tube terminals, distance from the tube focal spot to the skin; intensity (milliamperes) of the current passing through the tube; quality or effective wave-length (degree of

filtration), and time of exposure. An error in any of these factors may lead to more or less serious complications. At a given voltage, intensity (m.a.), and focal skin distance the quality and degree of filtration may greatly alter the latitude of exposure.

### REACTION OF THE SKIN

Radiodermatitis may be acute or chronic, and, like dermatitis caused by any other agency, may vary from a faint erythematous blush ending in pigmentation to violent inflammation with edema, and terminating in ulceration. While all stages of reaction may be encountered, it is convenient to consider acute radiodermatitis as occurring in three degrees.

**First degree.**—This includes the milder forms of reaction phenomena, characterized by erythema, a sensation of heat and depilation. It appears, generally, from ten to twenty days following exposure, as a diffuse blush. The patient complains of a hot or burning sensation. If the surface involved is relatively flat, and if the field exposed is confined to a geometric figure bounded by protective material opaque to the rays, the zone of reaction will be sharply outlined. However, such delineation will be more or less obscured or absent if the area exposed is concave or convex, or if no opaque material is used to limit the action of the rays. After three or four days the symptoms begin to subside and the erythema gradually gives way to a brownish or "tan" pigmentation. With this reaction may be included a slightly more severe grade in which all the symptoms are slightly accentuated and which ends in desquamation. Repeated doses to the point of first degree dermatitis, instead of increasing the tolerance of the skin, seem to render it somewhat more sensitive.

**Second degree.**—Here the irritation has been greater and the consequent reaction is more intense. The erythema appears a little earlier, is distinctly more pronounced, sometimes assuming a livid hue, and is followed by a stage of exfoliation lasting from one to three weeks. Slightly stronger dosage causes the vesicular phenomena to be more accentuated, and to be accompanied by exudation and an intense burning or "raw" sensation. This becomes particularly marked when the vesicles

begin to break and their epidermal covering to separate. For several days the resulting raw surface is bright red and covered with exuding serum. This gradually dries until a fresh epidermic layer has formed. The clinical picture may become complicated by mild infection. Before, or simultaneous with, the vesiculation, the primary erythema gradually shades off into a more or less marked epidermal bronzing. The symptoms, of course, are more pronounced and more distressing. Irritation to this degree leads to atrophy and, after from one to three years, to telangiectasis. If repeated several times at relatively short intervals (one to two months), it may, in a few cases, lead first to subcutaneous edema, and later to a dense brawny induration. However, this does not take place until months afterward and, according to our observations, only in obese persons. We have seen this end-result in two cases; in both, slight trauma caused sluggish ulceration which healed spontaneously.

The experiments of Martin have shown that increased heat and moisture, such as occurs between surfaces habitually or frequently in apposition (axilla, groin, perineum, and fatty folds in obese persons), have a distinct tendency to render the skin over such regions more radiosensitive. The topical use of certain chemical substances also has been shown to increase the sensitiveness of the skin. Among these may be mentioned iodine, scarlet R, mercury, pyrogallol, cantharides, resorcin, betanaphthol, tar, iodoform, sulphur, and salicylic acid. These substances are most potent in the form of ointments. While the importance of such knowledge is greatest in *x-ray* treatment of diseases of the skin, it is also of capital significance in any application of radiotherapy, it may frequently help to explain the occurrence of reactions of the skin which, otherwise, would be insoluble mysteries. It is on such factors as this and on unrecorded errors in technic that most of the reported instances of so-called idiosyncrasy are based.

**Third degree.**—To produce such extreme effects the exposure must be grossly overdone. They are practically always the result of gross errors in dosage estimation or administration. The result may be especially tragic if more than one dosage factor

is involved. In such cases evidence of extreme irritation may appear within two or three days, and, after passing through short stages of intense erythema and vesiculation, proceed to the point of ulceration. Such ulceration may be slight, moderate, or severe; it may involve only the skin or may extend into the underlying tissues. This destructive process has several distinguishing features; it is limited, either wholly or on one or more of its sides, by a relatively sharp outline corresponding to the area exposed; its surface is covered by a grayish or greenish-gray necrotic layer, with seropurulent exudate; the ulcerated surface gives rise to excruciating pain lasting for months or years, and the natural tendency to repair is held in abeyance. The acute phenomena gradually subside and the lesion passes into a chronic state characterized by pain, a dirty gray or greenish gray, papier mâché coating and little or no tendency to repair. The margins are irregularly thickened, extremely tender, and of a dusky red hue, indicating dense round-cell infiltration. In relatively mild forms of third degree reaction, the ulcerated surface may heal rapidly, but later, under the provocation of even very slight trauma, may again break down and remain indefinitely in a state of chronic ulceration. In other cases the involved area may remain intact for a long period without breaking down, but, if traumatized, small ulcers develop and gradually extend to the margins of the field. The patients suffer intense pain, sleep is seriously interfered with, and their general condition deteriorates. The severe and continued suffering frequently leads to the acquisition of the narcotic habit and, in some instances, suicidal tendencies develop.

It is an interesting fact that the injury to tissue to this extent is more common in radioscopy and radiography than in radiotherapy, and is usually the consequence of excessive zeal, lack of experience, or both. The roentgenologist, interested in some unusual finding, anxious to make a diagnosis in a difficult case, or wishing to observe the behavior of certain physiologic or pathologic phenomena, may lose sight of the total exposure, particularly if, after the roentgenoscopic examination, the same region is further exposed for serial roentgenograms. In such

cases it is usually the skin of the back, which, being nearest to the tube, bears the brunt of the insult.

### CHRONIC RADIODERMATITIS

Chronic radiodermatitis, according to the mode of its production, may be of three types: it may follow the acute phases of a third degree reaction as the result of a single grossly exaggerated exposure, it may appear as the late sequel of a moderately acute radiodermatitis followed by repeated exposure for a prolonged period. In some cases repeated exposure for many years, even in the absence of a primary acute dermatitis, may finally lead to chronic changes. The two last types are usually encountered in mature radiologists. It commonly involves the dorsum of the left hand because, in the early days, many pioneers not realizing the danger, and not having the advantage of our present knowledge and methods of protection, acquired the habit of testing the quality of their *x-ray* tubes by interposing the left hand between the tube and the fluorescent screen. This form of radiodermatitis is characterized by dryness, thickening, and a tendency to crack. Such a skin is easily irritated, especially by small doses of *x-rays*, and keratotic changes, frequently ending in epithelioma, are prone to develop.

Certain skin diseases having no relation whatever to *x-rays* are occasionally confounded with radiodermatitis. However, even without special experience, it is generally possible to distinguish the effects of the *x-ray* from the lesions of herpes zoster, for instance; the history of a relatively recent course of *x-ray* treatment, the ordinarily sharp outline (at least in part) of the zone involved, and the distribution should serve to clear up the problem.

### PROPHYLAXIS

Since the cause of radiodermatitis is obvious, and since the factors involved in its production are measurable within relatively accurate limits, its occurrence is quite preventable. However, the human mind is proverbially prone to error and it is doubtful if this factor can ever be wholly removed. Nevertheless, it is readily possible to minimize it considerably. In radioscopy and

radiography it is a simple matter to calculate the total permissible exposure under given working conditions, and the radiologist must train himself to keep within safe limits. In radiotherapy careful estimation of the dosage factors and one or more checks on these factors during the actual administration of the treatment will effectually prevent all but the mildest forms of radiodermatitis. There is no excuse for third degree reactions. Physicians lacking in experience must be particularly careful to bear the dreadful possibilities in mind and keep within safe limits. If they do not know what constitute safe limits, they have no right to attempt to use  $x$ -rays for diagnosis or for treatment. The uncontrolled employment of this agency by persons outside of the profession is both incongruous and unpardonable, and should not be tolerated.

In the practice of radiotherapy it is often essential, especially in dealing with malignant processes, to deliver a dose bordering more or less closely on the limit of skin tolerance. If this is to be done, the reasons and the symptoms to be expected should be explained to the patient beforehand; otherwise, when symptoms of skin irritation do arise, he may attempt to counteract them by injudicious means. As previously mentioned certain chemical substances have a tendency to accentuate the phenomena of irritation, and should not be used on a field recently exposed.

### TREATMENT

Radiodermatitis of the first degree hardly requires treatment. However, the sensation of heat may be sufficiently distressing to require a soothing topical application such as Dodd's lotion.<sup>1</sup>

<sup>1</sup> Formula of Dodd's lotion:

Phenol	. . .	1 85 gm.
Zinc oxid	. . .	15 5 "
Glycerin	. . .	4 0 "
Lime-water	.q s. ad.	250 0 "

After the bottle has been thoroughly shaken, the lotion is poured over a wad of absorbent cotton until the latter begins to drip. This sponge should then be gently dabbed over the inflamed surface, and the lotion allowed to dry. The application should be repeated so that the entire area will be thoroughly covered with the lotion. The second coat should likewise be allowed to dry before clothing is put on. This should be done night and morning for at least two weeks.



As the acute phase subsides itching may become more or less annoying and may be controlled to a considerable extent by continuing the use of the lotion for a week or ten days. Such remedies as borozin, zinc stearate, calamin lotion, aluminium acetate in 8 per cent stock solution and diluted 1 : 16 may also be used to advantage. In the second degree reaction the same



Fig. 142 —Area of radiodermatitis, right lower quadrant of abdomen, December 7, 1923 (photograph from original colored drawing) Entire area depressed from 5 to 8 mm. below the surrounding surface, and covered with dirty gray or greenish-gray necrotic papier mâché coating. Margins of area distinctly thickened and of dusky red hue. Considerable seropurulent discharge. Intense pain for months.

measures are useful, but, if the reaction should border on the third degree, less the ulceration, ambrine or paraffin dressings may be very useful.

During the acute stage, third degree, the dermatitis should be treated in much the same way as in the first and second degrees. However, after it has reached the chronic stage the method of

procedure depends on the site of the lesion and the character of the adjacent tissues. When it is possible to excise the whole area, and to bring healthy tissues into approximation, primary union and speedy convalescence can be assured. However, prior to undertaking such excision an attempt should be made to prepare the surface by cleansing it of necrotic material and bacterial products, and endeavoring to reduce marginal inflammatory phenomena. Primary union may be obtained, provided a sliding flap can be shifted into the excised area, and there is



Fig. 143 —Partial epithelization, December 17, 1923, and remaining central portion covered with granulations

sufficient blood supply in the flap for nourishment. Areas too large for excision and primary approximation can be excised, provided the underlying tissues have an abundant blood supply that will enable them to granulate. Grafts may then be planted and the wound allowed to heal, as in an ordinary skin graft wound. It is a mistake to attempt a skin graft on a poorly nourished surface, because the graft usually dies, or superficial infection develops and destroys the epithelium; nor should an approximation be attempted when the excised area is down

on fascial surfaces, and tension is necessary to secure approximation, because the sutures become infected and sloughing occurs, thus prolonging convalescence.

In cases in which primary excision and closure, either by direct approximation or sliding flap, cannot be accomplished, the areas may still be excised if circumstances permit, as the edematous tissue and necrotic layer are extremely annoying and painful, whereas a newly made wound, the result of excision,



Fig. 144 —Same area after twenty-one days' treatment, showing most of the surface covered with fresh, healthy epithelium, and progressing rapidly.

is preferable to attempting the treatment of an old burn. However, it is sometimes impossible to do other than treat the injured area as it is found when the patient presents himself for treatment.

For the last two years we have used what has seemed to be a very satisfactory method, considering the length of time x-ray ulcerations require to heal. Time must be calculated in months rather than in days or weeks. The method consists in

the use of hyclorite solution diluted from 1 : 20 to 1 : 30 and applied to the surface of the wound either by the Dakin tube method or by wet dressings frequently bathed with the solution. Hyclorite should be made up with cold water, because the chlorin it contains is liberated by heat and therefore lost. Usually the patient, if physically weak and depressed, should be hospitalized, and the Dakin tube method used. This treatment should be continued until the surface of the wound is cleansed of slough and exudate, and granulation tissue has formed a clean surface for epithelial repair. This epithelization will form a new protective layer for the whole wound. Occasionally, over an area in which the blood supply is scanty, it may be necessary, after the epithelium has apparently ceased to grow, to attempt to complete the protective layer by grafting. Such cases often tax the ingenuity of the best surgeons.

Direct sunlight will always be found a useful adjunct, but must never be filtered through glass, which removes the actinic rays and deprives it of the very properties for which it is useful. It should be administered in progressive, graduated doses, beginning with a minimum of three minutes and working up by regular stages to one-half hour. If, for any reason, sunlight is not available, artificial light, such as the Quartz lamp, is a useful substitute and should be employed in the same way. However, the wound should not be exposed to sunlight when hyclorite solution is being used, because dissociation of the solution takes place in the presence of the sunlight, liberating free chlorin, which combines with the water in the tissues to form hydrochloric acid.

Dressings with a paraffin base are beneficial when the granulations are clean; they serve to protect the surface from the air; they keep the area of the wound moist and may be removed without discomfort to the patient. However, they should be changed every twenty-four hours. If, as frequently occurs, a film of whitish exudate forms on the surface of the wound it indicates the use of hyclorite.

To illustrate the employment of these various agencies we will cite the following cases, the first being an example of non-

surgical treatment, the second, of treatment after attempted partial closure and subsequent skin graft.

**Case I.**—Mrs. H., first registered at the Clinic December, 1922. Her complaint was of multiple sinuses of the abdominal wall following a laparotomy performed elsewhere some months previously for appendicitis, in the course of which a tumor was encountered. When the patient was examined at the Clinic this was found to be part of an actinomycotic process. The sinuses were explored and later treated with radium and x-rays. By May 1, 1923, all but one sinus were healed and the patient was allowed to return home to continue x-ray treatment there.

She returned in November, 1923, with the history of having had two courses of x-ray treatment elsewhere, and on examination was found to have a third degree radiodermatitis approximately 20 by 12.5 cm. in size involving the right lower quadrant of the abdomen. The patient was mentally depressed from extreme suffering and had not slept two consecutive hours since the middle of July when the damaged area had broken down. She had been using narcotics to relieve pain and had lost 20 pounds. She was immediately hospitalized and given sedatives until we could get her under control. Nourishment was given freely, and continuous wet hyclorite irrigation by the Dakin tube method with a solution diluted 1:30 was instituted. Zinc oxid ointment was placed carefully along the edges of the wound to protect the painful margin, and paraffin mesh cut large enough to cover the area of the wound was applied, the edges resting on the ointment, thus protecting the border of the wound from irritation. The treatment was continued from November 13 to December 22. During this time narcotics had been discontinued, and the sloughed, thickened area and dead skin had either been excised or dissolved by the hyclorite solution. The epithelial borders were closing in so that, by December 21, the patient left the hospital and came to the Clinic for dressings. The paraffin method was then instituted. Parresine was sprayed over the whole surface. One thickness of gauze was tamped into the paraffin layer, and the gauze sponge covered with one

layer of parresine. The whole dressing was covered with a light layer of gauze, over which was placed an oval woven wire splint, the edges of which were covered by ordinary rubber tubing, such as is used for drainage purposes, and sewed on, thus giving a pneumatic cushion effect. A belt was sewed to one edge, and a buckle to the other, in order to hold the dressing in position and to permit the patient to go about comfortably. Gauze moistened with hyclorite solution was applied to the surface of the wound every three or four days for a period of about two weeks, and the patient was instructed to keep the dressing wet with the solution which was supplied. This was used for the purpose of dissolving the fibrinous exudate which consists of tissue products, cellular detritus, and bacteria. If this exudate is excessive, it forms a film over the underlying granulations, and when in contact with the epithelium along the edges of the wound, produces local inflammatory changes and erosion of the epithelial cells. Hyclorite dissolves this exudate and reduces the growth of bacteria to a minimum; the best results can be obtained by alternating the hyclorite treatment with parresine or ambrine dressings every two or three days.

This patient was dismissed recently with only 21.8 sq. cm. of granulation tissue remaining. We felt perfectly safe in allowing her to return home with this small unhealed area, to continue treatment under the supervision of her local physician. During her stay she had gained 22 pounds, and, so far as we could ascertain, was free from actinomycosis and in excellent health.

Case II.—Miss N. registered at the Clinic December 30, 1922. Five months previously she had undergone elsewhere repeated radioscopic examinations, supplemented by radiographs. One week later redness and vesicles developed on her back over an area 15 by 7.5 cm. In two weeks the entire skin sloughed away, and for the next few months she was treated with ointments, but without relief. Her wound became progressively more painful and irritated. She lost in weight and could not sleep. The area involved was located over the lower

dorsal vertebræ. January 7, 1923 the injured area was excised and drawn in by tension sutures in the hope of narrowing the gap, and later a Thiersch graft was inserted. January 17 a skin graft the size of the palm of the hand was grafted to the remaining area, and by January 29 the grafts had taken.

When the patient was dismissed from the hospital there was a small thin epithelial patch in the middle of the wound; the edges were covered with pus and slough and there was no attempt at healing. February 9 hyclorite dressings in a dilution of from 1:20 to 1:30, according to the comfort of the patient, were applied. This treatment was alternated with exposure to sunlight through an open window in graded doses, starting with a two-minute session and increasing to twenty minutes. When the wound was quite free from slough and exudate, paraffin was sprayed over it, as in the previous case, and alternate hyclorite and sunlight treatments were continued until May, when the size of the wound had reduced from approximately 125 sq. cm. to less than 6.25 sq. cm. The remaining portion of the wound was covered with epithelium. However, the patient remained in town for a month, fearing that the wound might again break down. *When she left in June it was still healed.*

In the chronic radiodermatitis of radiologists the problem of treatment assumes a different aspect. Since it involves a high degree of irritability, some means of protecting the skin from the source of irritation must be provided and constantly used during periods of potential or actual exposure. If this is not sufficient to overcome the irritative phenomena, some reorganization of the radiologist's professional activities must be made. He must arrange his work so as to avoid any possible exposure, no matter how slight, and it will be safer to make such rearrangement permanent.

If the cutaneous manifestations have reached the point of localized hypertrophy and keratosis, the measures mentioned are still more imperative. Ultraviolet light treatment may be given a trial, but the lesions should receive the close scrutiny and regular observation of an able dermatologist, who should decide if, and when, a biopsy is necessary. Small keratotic

patches may be destroyed by Oudin desiccation or, if advisable, by electrocoagulation.

Should the lesions actually be in a state of epitheliomatous proliferation, radical surgery should not be delayed. Sentiment is too often allowed to influence the treatment in such cases. Too frequently the surgeon, anxious to save as many fingers as possible for his unfortunate colleague, limits his excision too much. In a few months, or perhaps in a year or more, recurrence appears, and another finger or two, or a portion of the hand is amputated; too much precious time is thus wasted in half measures.

### CONCLUSIONS WITH REFERENCE TO TREATMENT

1. The mode of treatment depends on the location of the burn, the looseness of adjoining tissues, the thickness of the tissue, and the blood supply.

2. Hyclorite dressings are exceedingly beneficial in cleansing the wound, and seem to stimulate the epithelium. At least we do not believe that epithelial cells are deterred from proliferating by the dilutions used. Hyclorite is preferable to Dakin's solution, the chemical qualities of which are too inconstant.

3. Sunlight in conjunction with wet dressings is very beneficial.

4. Paraffin dressings permit the patient to get about, protect the wound, and apparently epithelium grows luxuriantly under it, if the surface is free from bacterial products. However, the dressing should be changed every twenty-four hours.

5. When a film of whitish exudate appears, the use of the wet hyclorite dressings is indicated, and in the course of two or three days the exudate will usually disappear. The use of paraffin dressings may then be resumed.

6. In the chronic radiodermatitis of radiologists half-way measures are pernicious. Early radical measures are safer in the long run, and sentiment should not influence the decision as to treatment.





## SYMPATHETIC OPHTHALMIA WITH RECOVERY OF VISION IN THE SYMPATHIZING EYE

WILLIAM L. BENEDICT

A WOMAN, thirty-five years of age, was referred to the Mayo Clinic July 5, 1923 with a diagnosis of sympathetic ophthalmia. A month before, the right eye was struck with a curling iron which tore a gash in the ciliary region (Fig. 145). At this time vitreous protruded from the wound. Enucleation had been advised and the danger of sympathetic trouble in the other



Fig. 145.—Section showing the wound in the ciliary region of the right eye.

eye carefully explained, but the patient had refused operation. The rent had been drawn together with a suture, and the eye healed nicely within a few days. Three days before, she had had flashes before her good eye, and enucleation was again advised. During the next few days the vision of the uninjured eye failed rapidly.

On examination at the Clinic vision was 4/60 in the left eye, and nil in the right eye. There was deep discoloration of the sclera of the right eye, with slight injection of the episcleral tissues and conjunctiva. About 3 mm. above the upper margin of the cornea was the scar of the wound, slightly contracted and sunken. The cornea was clear; the iris discolored. There was a coloboma of the iris above, just to the temporal side of the middle line. The globe was definitely soft to palpation. When viewed with the ophthalmoscope, the coloboma was seen to be filled with fibrous exudate which obscured a view of the fundus. The eye transilluminated very poorly.

The ocular conjunctiva of the left eye was slightly injected, and there was some deep pericorneal injection and chemosis of the conjunctiva in the outer quadrant. The cornea was diffusely hazy, the anterior chamber normal in depth, the pupil round, well dilated, and the intra-ocular tension - 1 to palpation. The media of the left eye were hazy. The color of the disk was good, and no lesion was seen in the fundus. Transillumination of the globe was subnormal. With the slit lamp wide folds were seen in Descemet's membrane in the left eye. There was no descemetitis. The anterior lens surface was covered with fine pigment deposits, and some large ones, but no synechia were formed.

Immediate enucleation of the injured right eye was performed under ether anesthesia. No sutures were used. Medical regimen was also instituted, 120 gr. of sodium salicylate were given by rectum daily. On the eighth day there was subjective improvement in vision. About this time repeated differential blood counts disclosed an increase in lymphocytes to nearly 50 per cent, but no increase in the total count, nor in the large mononuclears. For two weeks there were small amounts of albumin in the urine. During the third week the albumin disappeared, the lymphocytes decreased, and the percentage of polymorphonuclear cells was increased. On the eighteenth day, as the patient felt upset and complained of ringing in the ear, the salicylate was discontinued.

A few days after enucleation there were deposits on the

posterior surface of the cornea of the other eye, and vitreous deposits, and slight blurring of the disk margin. Atropin was instilled each day, and later dionin in 10 per cent solution was also used. The vitreous opacities gradually became less dense and smaller, and there was marked subjective improvement in vision. The patient left the hospital at the end of the third week, and five days later returned to her home. On the day of dismissal from the Clinic the vision had returned to 6/10 in the left eye, the visual fields were normal, the blind spot was only slightly enlarged, and the deposits had cleared away from the anterior capsule of the lens



## TWO CASES OF MELANOTIC TUMOR FOUND IN EYES THAT HAD BEEN ENUCLEATED BECAUSE OF PAIN- FUL UVEITIS WITH PHTHISIS BULBI

MARY S. KNIGHT

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THE first patient, a girl, aged nineteen years came to the Mayo Clinic September 22, 1923 because of loss of vision in the left eye. Following an attack of influenza six months earlier, the left lids became swollen, and the left eye badly inflamed and painful. The acute inflammation lasted for ten days. The condition began as acute iritis with hemorrhages and exudates, and was tentatively diagnosed as metastatic ophthalmitis.



Fig 146.—Section of shrunken globe showing the melanotic tumor.

When the patient was examined at the Clinic the vision was normal in the right eye, nil in the left. The left lids were discolored, the globe deep set and shrunken, with deep pericorneal injection. The cornea was small; the iris, off color and atrophic. The pupil was irregular, and covered with heavy membrane. The intra-ocular tension was  $-4$ , the eye was almost completely collapsed and still somewhat tender to palpation. Enucleation was advised. There was practically no postoperative reaction, and the socket healed promptly. When the globe was sectioned

a melanotic tumor was found which filled fully half the vitreous chamber, but was apparently still confined within the globe (Fig. 146)

The second patient, a man aged fifty-five years, came to the Mayo Clinic November 6, 1923, complaining of a blind, painful left eye. A year before, the left eye had slowly become blind without any pain or other symptoms. He had been told that he had a cataract, and no treatment was advised. In July, 1923, the eye had become red and painful. Under treatment the condition improved in two or three weeks, and remained quiescent until five weeks before the patient came to the Clinic, when it again became very painful, and a whitish area, which has persisted, appeared over the pupil.

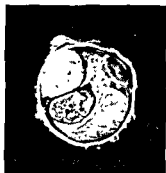


Fig. 147 —Half of eyeball, showing bilobed tumor.

At examination the vision, with correction, was found to be normal in the right eye, and nil in the left. The right eye was normal in appearance, and the intra-ocular tension to palpation was normal. The left eye was very tender, and the intra-ocular tension about -1 to palpation. The conjunctiva and sclera were intensely reddened. The injection was most marked near the limbus, which was not clearly defined. In the center of the cornea was a large, white, roughened area (6 by 7 mm.), which stained deeply with fluorescence. It contained several white nodules and the hazy peripheal zone of the cornea, 4 mm. wide, also contained several small whitish areas. There was a

fine vascularization of the peripheral portion of the cornea. The anterior chamber was very shallow, the iris discolored. Pupillary margins could not be seen, nor could the fundus be examined. A diagnosis of corneal ulcer and chronic uveitis with phthisis bulbi was made, and the eye enucleated. When the globe was examined a bilobular tumor involving the nasal wall from the disk to the ora serrata was found. Next to the wall was a white oval mass projecting 1 cm. into the chamber, and by the side of it, directly in front of the optic disk, was a smaller black oval mass (Fig. 147).

### DISCUSSION

In the second case the history is suggestive of intra-ocular tumor, but there was nothing in the first case to suggest intra-ocular neoplasms. Another confusing point in both cases was the subnormal intra-ocular tension. Although this does occur when tumors are present, secondary glaucoma is the usual picture.





## PSEUDOBRAIN ABSCESS

ALFRED W. ADSON

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IN reviewing the histories of patients coming to the Mayo Clinic on account of brain abscesses, I have found three unique cases in which there is a definite history of brain abscess. In two of these cases exploration revealed localized encephalitis; in the third case the patient was treated expectantly; all recovered.

The first patient, a girl fourteen years of age, came to the Clinic because of general weakness, and an afternoon temperature of one month's duration. The history of infancy is that of a normal child, who thrived on artificial feeding with a cow's milk mixture, and walked at the age of eleven months. She had had scarlatina at the age of eight years, pertussis at the age of eleven, and measles one month before admission. One week after the onset of the measles she complained of earache in the right ear, and on the following day the right ear began draining pus and continued to drain till the time of admission. About two weeks before coming to the Clinic she had had chills on three successive days, the first day her temperature rose to  $105^{\circ}$ , the second day it was  $103^{\circ}$ , and the third day it was  $101^{\circ}$ ; there were no chills thereafter. For about one week previous to her admission she had been in bed most of the time, because of marked general weakness, and an afternoon temperature of  $102^{\circ}$ . The day preceding admission to the hospital the patient had had severe pain in the right temporal region; there was no vomiting or visual disturbance.

Examination revealed a weak, pale, languid child, with palpable cervical glands on both sides of the neck, enlarged tonsils, and no discharge from the ear at the time of examination; there was no tenderness or pressure over the sinuses or mastoid processes: the systolic blood pressure was 112, and the diastolic,

78. The pulse was 102, and the temperature at 10 a.m. was 100.2°. The specific gravity of a passed specimen of urine was 1.017; the urine was acid in reaction, with a very faint trace of albumin, and an occasional pus cell. The hemoglobin was 68 per cent, the leukocytes numbered 11,900, the differential count was lymphocytes, 21.5 per cent, large mononuclears 2, transitionals 3.5, neutrophils 72.5, and basophils 0.5 per cent; there was slight poikilocytosis. The Wassermann reaction on the spinal fluid was negative, a Nonne test was positive and there were three small lymphocytes for each cubic millimeter; the result of the colloidal benzoin test was 000 000 120 000 000, with increased cerebrospinal pressure; the von Pirquet test was negative and also the blood culture. Roentgenograms of the lungs were negative. Roentgenograms of the mastoids revealed a normal mastoid on the left and a cloudy mastoid on the right, with destruction of cells. There was a discharge from the ear, and a small gland below the tip of the mastoid; otherwise the objective ear findings were negative, as there was no drooping of the canal, no interference with the hearing, and no nystagmus. The history of chills and fever made one suspicious that a sinus thrombosis or at least a septic absorption had existed.

In view of the history of ear findings, a wide paracentesis of the right ear was advised, and performed. The procedure resulted in a copious drainage of pus from the middle ear, but there was only a slight drop in the temperature. The mastoid was then explored by Lillie, who found infected granulation tissue within the cells with some destruction, but without free pus; the sinus did not give evidence of thrombosis. After this treatment the septic temperature subsided and the patient improved, but she still complained of tenderness over the right temporal area, and the leukocyte count ranged from 10,000 to 18,000. There were choked disks of from three to four diopters with hemorrhages, and left facial paralysis.

Three and one-half weeks after the patient's admission, following the paracentesis and mastoid exploration, the temperature was found to be about normal; there were no further

chills and the general condition had improved. The child was able to be up and about, but the leukocyte count was slightly above normal, the left facial paralysis was progressing, and there was an increase in the choked disks, with percussion tenderness and pain over the right temporal area. These findings indicated that the patient had developed a localized encephalitis and abscess in the right temporoparietal lobe, and exploration was advised, and performed, just one month after the patient's admission. On exposing the cortex over the right temporal lobe the arachnoid appeared cloudy; there was an accumulation of fluid in the subarachnoid spaces and the convolutions were congested, but there were no adhesions between the arachnoid and the dura. I protected the wound with cotton pledgets, and inserted a cannula into the upper convolutions of the temporal lobe; resistance was encountered just beneath the surface of the cortex, which seemed to be caused by the capsule of the abscess, but upon inserting the cannula into this resisting mass, no pus was obtained. I inserted the cannula for a distance of from 3 to 4 cm. into this mass, when the instrument apparently passed through the mass, as some blood-tinged cerebrospinal fluid was obtained. The sphenoidal and temporal and parietal areas were then explored, but at no time was free pus obtained. Inasmuch as the ventricle had been entered, I injected a small quantity of air to obtain a ventriculogram; this revealed normal lateral and third ventricles, with the exception of a poorly filled anterior horn of the right lateral ventricle.

The patient's convalescence was uneventful; the choked disks began to subside following the decompression, the facial paralysis disappeared, and the patient was dismissed on the tenth day, with the wound healed by primary union. The patient has remained well for more than six months.

In this particular case I expected to find a brain abscess, and one month was permitted to pass before exploration, with the hope that the abscess would become localized and immunity established before drainage was attempted. However, localized encephalitis apparently developed which did not break down and become suppurative, but disappeared spontaneously.

The second patient was a girl, also fourteen years of age. She came to the Clinic because of weakness in the right side of the body, motor aphasia, headache, and local tenderness over the left temporal area, of two months' duration. Her previous medical history was negative, except that she had had scarlatina just before the onset of her present trouble, of which this infection may have been the origin. Her symptoms began with a chill, followed by fever, vomiting, sore throat, and the development of palpable cervical glands, more markedly enlarged on the left side. There had been a general convulsion on the first day of her illness, followed by indefinite eruptions, which were not typical of scarlatina. At the onset the temperature was 105°, and continued very high for the first week, then ranged around 100° and 102°. The final diagnosis made with reference to the onset of her illness was streptococcic sore throat, bilateral otitis media with profuse drainage, and cervical adenitis. Three weeks after the onset of the illness the left cervical glands were drained, and one ounce of thick yellow pus was obtained. In four weeks from the date of her first illness the patient had improved to such an extent that her temperature became normal, and she was permitted to be up and about, at no time had there been evidence of mastoiditis. The improvement continued for a period of three weeks, then she began to show signs of cerebral disturbance, was irritable with subsequently drowsy periods and a beginning right homonymous hemianopsia developed with slight swelling of the left optic disk. The Kernig sign was positive, and the neck stiff, and there was some hyperesthesia of the right arm and face. The following day there was definite weakness in the right arm and leg, and the general condition remained about the same, with the exception of somewhat improved mental symptoms.

Examination revealed systolic blood pressure 116, diastolic 86; pulse 104, and temperature 98°. The specific gravity of a twenty-four-hour passed specimen of urine was 1,005, the reaction acid; there was a trace of albumin, and an occasional pus cell. The hemoglobin was 50 per cent, the leukocytes numbered 14,200; the differential count was lymphocytes, 30.5 per

cent; large mononuclears, 4.5, transitionals 3.5, neutrophils 56.5, eosinophils 4, and basophils 1; there was slight anisocytosis and slight poikilocytosis. Examination of the ears revealed nearly total destruction of the membrana tympani of the right ear; the patient could hear a whisper. There was definite tenderness over the mastoid area with some edema of the tympanic membrane on the left side. This ear was examined later by Lillie, and the mastoid tenderness was found to be greatly diminished; a mastoid operation was, therefore, not advised. The pupils were equal, and reacting to light and accommodation; the fundus showed little or no papillo-edema, but there was contraction of the right half of both visual fields. The neurologic examination disclosed weakness of the right side of the body, with exaggerated reflexes, pain on flexion of the neck, and definite mental disturbance. A spinal puncture was not performed for fear a brain abscess might be opened. (The leukocyte count varied from 14,000 to 7,000, but averaged more than 12,000.) The patient was admitted to the hospital eight weeks after the onset of her illness and was kept under observation for nine days, because the weakness in the right hand and face improved for the first three or four days; but when this condition became stationary and there still existed a weakness of the whole right side of the body, right homonymous hemianopsia, slight blurring of the optic disks, partial motor aphasia and tenderness over the left temporal area, exploration of the left temporal lobe for brain abscess was advised.

The patient was operated on nine weeks after the onset of her illness. The operation consisted of exploration of the left temporal lobe, and on reflecting the dura it was not found adherent to the arachnoid, but the arachnoid was cloudy with an accumulation of fluid in the subarachnoid spaces, and there was marked congestion of the vessels in the pia mater and cortex. After making preparations for opening an abscess a cannula was inserted into the temporal lobe and a boggy mass was encountered, more resistant than normal brain tissue, but free pus was not obtained. The cannula was then inserted in the region of the temporosphenoidal lobe and into the parietal lobe, where

the ventricle was entered, and about an ounce of bloody cerebrospinal fluid was obtained; this was cultured and found to be free from organisms. A large decompression was made over the left temporal lobe. Immediately after the operation there was a slight rise in temperature to  $101^{\circ}$ , which subsided in two days and ran a normal course until the patient's dismissal on the twenty-seventh day.

The weakness of the right arm and leg and face improved but little during the first ten days after operation, it then began to disappear, and by the time the patient was dismissed she was able to walk, and to use the hand fairly well, but with considerable awkwardness in the finger movements. The homonymous hemianopsia improved, and when the patient returned for examination one month after the operation, the fundi and fields were found to be perfectly normal; there still remained slight weakness in the right arm, hand, and leg. Examination two months after the operation revealed marked improvement in the weakness of the right side, so that nothing remained but a little awkwardness in the right hand. The condition of the eyes was normal, and there was marked improvement in cerebation, the weakness of the face disappeared about this time. Four months after the operation the child was normal except for slight irritability and very slight awkwardness in the movements of the right side; but she had had two petit mal convulsions with subsequent impairment of the movements in the fingers of the right hand. At the present time, five months after the operation, her condition is normal, but she has had a third petit mal convulsion, which, however, left no residue. The patient is carrying on school work and appears normal, both mentally and physically.

I believe that this patient's disease was the same as that in Case 1, but apparently the lesion was a localized encephalitis which did not break down in suppuration, but disappeared spontaneously.

The third patient was a girl thirteen years of age. She came to the Clinic February 6, 1922, complaining of violent headache, most severe over the left frontal area. She had had three attacks

of pneumonia before she was three, and a tonsillectomy at the age of three. She had had otitis media in 1915, for which drainage had been instituted, with relief. The condition recurred in 1916, was again drained, and a simple mastoid operation performed. In 1917 the patient had further difficulty which necessitated a radical mastoid operation, with exposure of the sinus. The wound appeared to heal and then break down again. In 1918 further drainage in the mastoid area was necessary, and the patient's temperature was  $104^{\circ}$ , associated with headaches for thirty-six hours, and an attack of vomiting. In 1920 the patient had further trouble with the left ear, so that drainage was again necessary. In 1921 she experienced an attack of very severe left supra-orbital headache; January 10, 1922 she developed a streptococcic sore throat and had a temperature of  $103.2^{\circ}$ , with enlarged glands, but no evidence of ear involvement. January 26, 1922 she again developed severe headache; at this time the leukocyte count was 31,000, and a left supra-orbital headache lasted five days. February 6 the patient had a violent headache which began abruptly and was so intense as to cause her to scream; at this time the pulse rate became slow (about 50 each minute) and irregular. This condition lasted for about twenty-five minutes, during which time the mentality was clouded and the patient did not appear to know where she was nor what was going on about her.

Immediately following this attack the patient was seen by a neurologist at the Mayo Clinic, who reported negative findings, except that the right pupil was slightly larger than the left, and that there was evidence of some aphasia, in that the child was unable to use the words she desired to express herself; the leukocyte count was 16,000. The left mastoid area was again explored and only granulation tissue could be found. February 7 the patient was admitted to the Kahler Hospital. The temperature was normal. The leukocyte count was 16,700; the differential count was: lymphocytes, 21.5 per cent; large mononuclears, 4.5; neutrophils, 73.5, and eosinophils, 0.5; the hemoglobin was 78 per cent, and there were 4,480,000 erythrocytes. There was a granulating mastoid wound. The eyes



were normal. The specific gravity of a passed specimen of urine was 1,014, and the reaction acid; there was no albumin, but an occasional pus cell. The neurologic examinations gave evidence of impaired stereognosis, a very mild motor aphasia, and left supra-orbital pain. The patient was kept under observation until February 19, the date of her dismissal. During this period of observation repeated examinations of the blood, urine, fundi, and nervous system were conducted. On the third day of observation the patient had a second questionable convulsion in which she developed mental disturbance with slight weakness of the right hand; she did not lose consciousness, but was confused. The leukocyte count continued to remain fairly high, ranging around 16,000 until the day before her dismissal, when it dropped to 11,200.

This patient probably had encephalitis of the left temporal lobe, and brain abscess, but inasmuch as she had a draining mastoid, no choked disk, no paralysis or permanent aphasia, I did not feel justified in exploring the temporal lobe in the presence of an open suppurating mastoid wound. With special dietary measures the patient began to gain weight and strength and was able to be about at the time of her dismissal. During the subsequent period of almost two years she has remained perfectly well, has become fairly robust and active, and is doing excellent school work.

In the analysis of these three cases the important point is that each history is rather typical of brain abscess, since there was first a history of otitis media and mastoid involvement, then acute encephalitis with cerebral symptoms, and a retrogression of the cerebral symptoms with evidence of a localized cerebral involvement. The temperature was normal or slightly elevated, and leukocytosis moderate, the count ranging from 14,000 to 18,000, and the *cerebrospinal fluid findings were negative*. It is known that brain abscesses pass through three distinct developmental changes; the initiatory, the quiescent, and the terminal. During the initiatory stage the infection reaches the cranial contents by direct extension, as from an infected middle ear, or a fractured skull, or by septic emboli from a dis-

tant chronic process. The direct invasion may occur through phlebitis of the tributary vein of a thrombosed blood sinus, or by osteomyelitis, localized meningitis, and encephalitis. At the onset the process is diffuse, and is often spoken of as "acute softening of the brain." If the pathogenic organism is extremely virulent, the process spreads rapidly and causes death, but if the resistance of the body is sufficient, localized encephalitis develops which subsequently breaks down in the center, but develops an area of induration on the periphera, giving the impression of a capsule around the abscess. If this takes place the abscess reaches the quiescent stage; there is recovery of the encephalitis around the abscess, which accounts for the retrogression of the cerebral symptoms. The abscess then presents symptoms similar to those of brain tumor, either localized or unlocalized, depending on the position of the abscess, except that the temperature may remain slightly elevated, but not septic in character, and the leukocytosis slightly above normal, the average count being 16,000. Symptoms of meningitis are usually present in the initial stage, but are absent during the quiescent stage, giving a normal cell count for spinal fluid unless the process of encephalitis continues. The terminal phase is either death or recovery; death usually follows a rupture of the abscess into the ventricle or into the subarachnoid spaces, or it may follow an extension of the abscess into normal brain tissue, which again gives rise to acute encephalitis and basilar meningitis. A small group of patients apparently recover from the small abscess if their resistance is exceptionally high, and the virulence of the organism low. The pus becomes inspissated and the abscess cavity and capsule heal into one dense scar, as occasionally seen in traumatic cases. A third condition must also exist, and this is typified by the three cases reported here, particularly the first two, which we have named pseudobrain abscesses because the history and clinical findings simulate typical brain abscesses; however, the lesion, instead of breaking down into a suppurative mass, remained a localized encephalitis with sufficient blood supply retained to aid in spontaneous recovery.

Two important facts can be gleaned from the study of these three cases: first, that a localized encephalitis may have a history and findings similar to a brain abscess, and second, that the condition is cured spontaneously. Hence the surgical treatment should not be too hastily advised, since little is accomplished if operation is performed in the initiatory stage; if in doubt, however, an exploration should be performed during the quiescent stage in order to rule out the possibility of a brain abscess, and this procedure does no harm if a localized encephalitis is found. Even a decompression may be of value in relieving the pressure over the localized encephalitis.

## SUPPURATIVE LABYRINTHITIS

HAROLD I. LILLIE

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EXPERIENCE with labyrinth disease has shown that by far the most important feature in its successful management is the correct diagnosis. In certain cases the diagnosis is made with relative ease, while in others great difficulties are presented. In certain cases surgical interference with the labyrinth is not necessary, in others definite exact surgical procedures are imperative. The incidence of labyrinth disease in cases of chronic suppurative otitis media with mastoiditis is not high, but high enough so that it is necessary to be able to make a diagnosis when the occasion arises. The suppurative involvement of the labyrinth adds considerably to the gravity of the case so far as mortality is concerned. Otto Rott reviewed the literature on the indications for operative interference on the labyrinth up to 1916, and his comprehensive article is interesting and enlightening. It has been shown that the labyrinth function may be destroyed by disease processes, and the patient recover without operative interference and without further symptoms from the labyrinth. The labyrinth capsule has been encountered as a sequestrum; these are instances of extreme good fortune. In one's daily practice nonfunctioning labyrinths may be encountered, in which there are no signs or symptoms of active disease of the ear or labyrinth. In such instances, interference does not seem warranted, as natural processes have accomplished the desired result. The four cases presented here are representative of certain types of labyrinth disease. In a rather extensive experience in the Mayo Clinic during the past seven years with diseases of the labyrinth it is believed that every described type of labyrinth involvement has been encountered.

**Case I. Toxic or metastatic labyrinthitis.**—Three weeks before her registration at the Clinic, this patient, a woman aged twenty-four years, suddenly felt a sensation of water in her right ear, at about 9 a.m. She attempted to wipe the fluid out, with no relief. By 10-30 deafness was complete. About 11 dizziness began, slight at first. Vomiting began on the evening of the first day and recurred if the patient attempted to move. She was confined to bed for one week, and could not move around until the end of the second week. There was no vomiting after the first week, and no dizziness after the fourth week; tinnitus was constant, deafness complete, and gait unsteady.

The blood count, urinalysis, Wassermann reaction, general physical and eye examinations were negative. Complete examination for syphilis was also negative. Examination of the ears demonstrated complete nerve deafness in the right ear, with normal hearing in the left ear. On caloric stimulation a delayed response was obtained through the vertical canal on the right side, but none through the horizontal. There was no past pointing. Examination of the canals on the left side showed them to be normal.

The patient was placed in the hospital and given pilocarpin sweats and purgation. On the fourth day loud noises were heard, on the fifth day conversational voices, and on the seventh day loud whispers, *ad concham*; tinnitus was in no way affected. Three months later it was possible to get caloric stimulation through the right horizontal canal and past pointing was normal on caloric stimulation of both canals.

**Discussion.**—In this case it was difficult to differentiate metastatic labyrinth involvement from toxic labyrinthitis. In experimental animals occasionally the labyrinth is found to be involved and it is only reasonable that this would occur in man. The question of management of this type of case is important. In making a diagnosis in this case it did not seem that a suppurative disease process would have permitted symptoms to exist over such a long period, as in my experience symptoms resulting from a suppurative disease last a much shorter time than those of a serous process. The explanation for this is that

the suppurative disease is much more destructive, and therefore destroys the labyrinth much sooner. With this in mind the patient was treated for toxic labyrinthitis.

**Case II.**—Circumscribed suppurative labyrinthitis, followed by diffuse suppurative labyrinthitis.—This woman, aged twenty-eight years, had had a discharge from the left ear for a few weeks fifteen years before, following one of the exantheams, but there had been no trouble since. The acute symptoms began suddenly during the night; on attempting to get out of bed the patient fell, and found she was more comfortable lying on the right side. She had severe frontal headache, but no pain in the ear. There was slight nausea, but no vomiting.

Physical, neurologic, fundi, and laboratory examinations were entirely negative. The ear, nose, and throat examination was negative except that the left tympanic membrane was found to be red, but not full; there was no perforation. A spontaneous rotatory nystagmus to the left was observed. The patient heard a conversational tone with the left ear when exclusion apparatus was used in the right. No reaction from the caloric test was obtained. Incision of the tympanic membrane released foul pus. The acute symptoms were considerably relieved quickly.

After ten days in the hospital the symptoms were entirely relieved, but the ear continued to discharge. The patient left the hospital against advice. Five days later she returned, unable to walk because of vertigo; headache was very severe. Examination revealed a nonfunctioning cochlea and labyrinth. The diagnosis naturally was diffuse manifest labyrinthitis. There was no clinical evidence of meningeal irritation or involvement; symptoms improved and at operation two weeks later extensive destruction in the region of the antrum filled with a definite cholesteatoma was found. Removal of the cholesteatoma revealed a fistula in the horizontal and anterior vertical canal. The labyrinth was drained after the method of Hinsberg. The postoperative course was without incident.

*Discussion*—The question naturally arises, how could a

cholesteatoma form, or exist in a mastoid antrum, without evidence of a perforation? It is claimed that all cholesteatomas are the result of a marginal perforation, and that a symptomless cholesteatoma could hardly be expected. However, the history of suppurative disease in the ear fifteen years previously without subsequent symptoms would naturally explain the presence of the cholesteatoma. When the patient was first seen she was acutely ill, and because it was found on examination that the process was not diffuse, she was managed expectantly and the symptoms disappeared, to return in the course of a very few weeks. After the subsidence of the acute manifestation of the disease, the operation was performed with the findings as noted. In the presence of acute circumscribed labyrinthitis a radical mastoid operation would have been considered good practice. In encountering the fistula the question would arise of whether or not the labyrinth should be drained. Certain observers believe that the fistula should not be interfered with, but my experience has led me to believe that if operative interference is instituted early and a fistula is encountered, it is best to open the labyrinth. At the time this patient was operated on, after the subsidence of acute symptoms from the diffuse labyrinthitis, there was no alternative. The Hinsberg operation was performed in this case because there were no symptoms of extension.

**Case III. Chronic suppurative otitis media with mastoiditis with acute suppurative labyrinthitis, facial paralysis, meningitis.**—A farmer, aged thirty-nine years, came to the Clinic with chronic left suppurative otitis media, active, with vertigo, vomiting, and headache. About fifteen years before he had had a left earache, followed by spontaneous rupture of the tympanic membrane, a foul-smelling discharge, and deafness. The left ear had discharged almost continually. Two weeks before he suddenly developed vertigo and vomiting. He consulted a nearby aurist, who advised hospitalization. The temperature was 102; the leukocyte count was 24,300. After a week's rest in bed the patient left the hospital somewhat improved, but came immediately to the Clinic. He complained of having had

"chills" the last two nights, and vertigo and vomiting on the train.

The patient was too weak to permit satisfactory examinations of the larynx, pharynx, and nasopharynx, but mucopus was found from the nasopharynx. Examination of the nose was negative. He had much dental sepsis. The tonsils were small and soft. The tympanic membrane of the right ear was retracted; that of the left ear was thick and retracted against the middle wall, with a perforation at the lower margin and a foul discharge. There was rotatory nystagmus to the right, and slight left facial paralysis of the two lower branches only. A clinical diagnosis was made of chronic suppurative otitis media with purulent labyrinthitis, facial paralysis, combined type deafness, left, normal right, and probable generalized meningitis.

The patient was hospitalized. The next day he heard a conversational tone of voice through the left ear, with exclusion apparatus in the right ear. The left facial paralysis was more marked. He was more comfortable lying on his right side. Two days later his condition was worse. Meningitis was definite. The Babinski sign was positive. The neck was rigid, and he lay with his head drawn backward. Spinal drainage was made daily.

Ten days after admission to the hospital a left radical mastoidectomy and labyrinthectomy after the method of Neumann were performed. The mastoid was anatomically atypical. Trautman's triangle was much contracted and solid. The dura of the middle fossa hung lower than the middle ear. The mastoid antrum was reached with difficulty, and a large mass of cholesteatoma was encountered. The middle ear and the attic were filled with infected granulations, which were somewhat difficult to remove. An extensive fistula was found in the horizontal canal and the base of the vertical canal. The face could be made to move by touching the facial nerve below the horizontal canal in front. The dura over the posterior aspect was much reddened, and showed definite plastic lymph. In exploring the region of the endolymphatic sac, a small amount of fluid came away. The bone was removed down to the internal



auditory meatus, and through and through drainage from the promontory posteriorly was established. The face could be made to move at the completion of operation. Plain gauze wicks were placed against the promontory, and a vaselin pack over the dura. The posterior wound was left open.

*Discussion*—In this instance, the patient presented definite evidence of extension of the disease to the meninges, and it was apparent that if surgical intervention was not instituted the patient would succumb, because during the time that he was under observation little or no progress was made, and, in fact, a very grave prognosis was given to his relatives. As may be noted in the résumé of the case, the disease was very extensive, but after exposing the dura along the angle and apex and allowing for good drainage the patient recovered. The differential diagnosis of peripheral and central lesions involving the seventh and eighth nerve, particularly in the presence of meningitis, is difficult. I believe that an important differential diagnostic point is the fact that when these nerves are involved at the angle, the symptoms are of much shorter duration than when the lesion is in the labyrinth. However, the eighth, ninth, and seventh nerves may be involved by peripheral lesions. One might expect that the sixth nerve would be involved, as in Gradenigo syndrome, in the angle lesion. In such cases the pain seems to be more deep seated than if the labyrinth is involved, even though the disease has extended from the labyrinth. Reference to the history will show that the Neumann operation was performed because it would expose the apex and the angle and allow for drainage and tamponing of the dura, and thus have a tendency to limit the disease. Further, in cases in which symptoms of a cerebellar abscess developed, the region would be sufficiently exposed to allow for drainage of the abscess.

*Case IV. Otitis media, suppurative, chronic, with mastoiditis, diffuse suppurative labyrinthitis, and cerebellar abscess.*—A man, aged thirty years, came to the Clinic because he had had a foul discharge from the ears for several years. The discharge from the left ear had begun eight years before, and had

continued constantly. It had a foul odor and varied in amount. There had been no particular pain. The right ear had begun to discharge two years before, following a cold. The patient had been dizzy for the last three months whenever he bent and straightened up quickly.

A nasal obstruction, due to a badly fractured septum, was found. The right ear showed destruction into the attic, from which an epithelial-like débris and a small amount of foul-smelling pus could be removed. In the left ear was a large central perforation filled with granulation. A low whisper was heard with both ears. The right ear cleared up in a few days, but the left improved little, or not at all after prolonged treatment.

A radical mastoid operation on the left side was performed. The dura was uncovered by the disease. Three days later a definite diffuse labyrinthitis developed; symptoms gradually subsided and in ten days subjective symptoms had cleared. The patient was dismissed to out-patient service. After a month he complained of distress deep in the head, developing into definite headaches over the occipital region. Slight ataxia on rising was quickly compensated for. Neurologic examination revealed signs of cerebellar involvement; nystagmus was manifested in all directions. The patient was hospitalized. He became rapidly worse, and his mentality clouded; the fundi were found to be negative. Spinal fluid was definitely cloudy and contained 618 cells. A diagnosis was made of cerebellar abscess secondary to labyrinthitis. A second operation revealed an abscess; labyrinthectomy after the method of Neumann was performed. Recovery was uneventful. Subsequently the radical mastoid operation was performed on the right side, with the idea of avoiding the sequence of events that occurred on the left side. The hearing did not change in the right ear. The patient has been well since.

*Discussion.*—It will be seen that this patient developed a labyrinthitis following a radical mastoid operation, that the symptoms subsided, and that later evidence of a cerebellar abscess developed. Surgical interference was not instituted

during the acute stage, but the process was allowed to limit itself, and then operation of the labyrinth after the method of Neumann and incision of the dura over the cerebellum in front of the knee of the sinus drained the cerebellar abscess. The abscess might have been opened too early, but as has been shown many times, the preferable time at which to open a brain abscess is after it is formed and walled off. The postoperative management of this particular case is of interest, since instead of using a permanent drain in the abscess cavity, it was opened daily by forceps, and intracranial pressure allowed to expel the pus. The result was gratifying, as the convalescence was much shorter than in the usual case of brain abscess. The reason for the development of this labyrinthitis is not apparent. Symptoms developed several days after the radical mastoid operation, and it was believed that the process must be serous labyrinthitis. Subsequent developments, however, proved it to be of the suppurative type.

In the successful management of patients presenting themselves with labyrinthian disease, the diagnosis is by far the most important feature. Patients must be dealt with as individual problems rather than in a routine generalized manner. With a diagnosis based on the information to be had, the correct surgical interference will suggest itself. Surgical interference instituted too early in the process is usually not so successful as that which is deferred to a time when conditions are more favorable.

## GIANT-CELL TUMOR. SOLID ODONTOMA. HYGROMA CYSTICA. THYROGLOSSAL DUCT SINUS.

GORDON B. NEW

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**Case I. Giant-cell tumor of the upper jaw.**—This young man aged nineteen years, a farmer by occupation, came to the Clinic on account of a growth in the upper jaw which had been noticed eleven years before, after having been hit on the upper jaw with a log. The lump gradually increased in size, and was treated electrically from time to time, but its growth was not affected.

Examination revealed a huge, hard tumor of the upper jaw, involving the nose and cheek. The upper jaw extended anteriorly 10 cm. further than the lower. Many of the upper teeth were missing, and those remaining were very irregular. The tumor bulged into the nasal cavity from below, so that it was impossible to see either nostril. In the mouth the tumor extended about half-way back on the hard palate (Figs. 148, 149). The lateral view in the roentgenogram shows a very extensive tumor with trabeculation involving the upper jaw and antrum, and displacing the nose (Fig. 150).

The growth was explored, under ether anesthesia, and found to be a giant-cell tumor. It was removed in four stages by means of bone forceps. Two months afterward a 50 mg. tube of radium was inserted directly into the center of the tumor for twenty hours (Figs. 151, 152). For a period of more than three years the patient has had no further trouble, and the tumor has not recurred.

*Comment* —Giant-cell tumors of the jaw may occur as central or as surface tumors. The latter is usually called an epulis and is by far the more common. It is pedunculated, and reddish, occurring usually along the margin of the gum, and frequently



Fig. 148.



Fig. 149.

Figs 148, 149.—(Case 1) Giant-cell tumor of the upper jaw, antrum, and nose

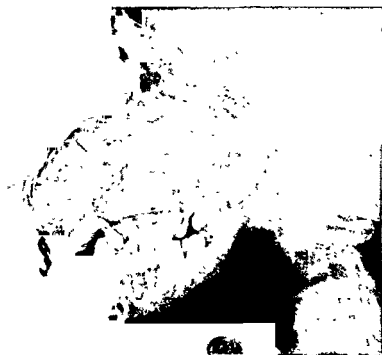


Fig. 150.—(Case I.) Roentgenogram of tumor. Note the cystic character of the tumor and the trabeculation.

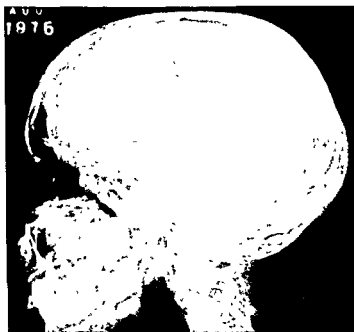


Fig. 151.—(Case I.) Postoperative roentgenogram.

originates from the periosteum of a tooth socket, so that in removing it the two adjacent teeth should be removed and the socket cauterized in order to prevent recurrence. The central tumors gradually bulge the bone, producing a cyst-like cavity which is filled with a reddish, raw-meat-like material. Giant-cell tumors are benign. It is usually impossible to make a definite diagnosis of this type of tumor from the roentgenogram alone; it should be corroborated by clinical and microscopic data. The operative treatment is simple. The contents of the cavity are removed with a curet and the cavity cauterized with actual



Fig 152.—(Case I.) Patient after operation

cautery, or radium may be used, as was done in this case. I have never seen a giant-cell tumor of the jaw recur when treated by this method.

**Case II. Solid odontoma.**—This boy, aged ten years, came to the Clinic because of a tumor of the right lower jaw which had first been noticed two years before. He has had no treatment, either medical or surgical. Examination revealed a hard, bone-like tumor of the right lower jaw extending from the right cuspid region to the angle. The jaw was about 5 cm.



Fig. 153.—(Case II.) Solid odontoma of the lower jaw.



Fig. 154.—(Case II.) Postoperative roentgenogram of the jaw.

thick. There was no ulceration, and the mucous membrane of the surface was normal in appearance. The x-ray revealed a



solid, bone-like mass in a cyst-like cavity in the lower jaw, involving two-thirds of the body of the jaw (Fig. 153). A diag-



Fig. 155.—(Case II) Gross specimen, solid odontoma of the lower jaw.

nosis of solid odontoma was made, and under ether anesthesia the tumor, which was in the cystic cavity, was shelled out with-



Fig. 156 —(Case II) Photomicrograph of solid odontoma. Note the areas of adamantine tissue and other areas of cementum and fibrous tissue.

out difficulty (Fig. 154). It was 8.75 by 6.75 cm. in size, and filled the entire cavity. Adamantino-cementoma was revealed

on microscopic examination (Figs. 155, 156). The patient has had no trouble since the operation.

*Comment.*—Odontomas may be solid or cystic. The solid type are much more unusual. Bland-Sutton refers to this type of tumor as a composite odontoma. Its structure originates from all the elements of a tooth germ. The bone-like mass is simply an irregular growth of the enamel organ. It may consist of the germs of several teeth, and is found more frequently in the lower than in the upper jaw, and usually at the angle. It may be present for many years, and may be found only when the  $x$ -ray reveals its presence, or secondary infection occurs between the tumor and the bone, causing symptoms similar to osteomyelitis. Like an osteoma, the tumor grows very slowly. The mass revealed by the  $x$ -ray may be mistaken for an osteoma. The tumor may be readily enucleated. It is usually best to remove the outer wall of the cystic cavity, which remains after removal of the cyst, in order to avoid a cup-shaped pocket.

**Case III. Hygroma cystica treated with radium.**—A girl, aged fourteen months, was brought to the Clinic for examination because of a tumor of the neck. About two weeks after birth the parents noticed slight fulness of the right side of the neck, which remained stationary until the child was about seven months old, then gradually grew larger. The child was well otherwise. Examination revealed a soft, cystic tumor of the right side of the neck, extending from the angle of the jaw on the right side to the left of the middle line, from the cheek and submaxillary region to the clavicle (Fig. 157). A diagnosis of cystic hygroma was made. One thousand milligram hours of radium was applied over the mass, using 2 mm. of lead and an inch of wood screening. The treatment was repeated one week later, and six similar treatments were given from two to three months apart, the tumor gradually reduced in size until it is now scarcely noticeable (Fig. 158). A small nodule is all that remains of the extensive tumor. This may be removed.

*Comment.*—The results in this case following treatment with

radium are particularly satisfactory because of the fact that the surgical removal of these cysts in infants does not always produce such good results. The cysts are usually very thin walled, and their multilocular character makes complete removal diffi-



Fig 157



Fig. 158.

Fig 157.—(Case III) Hygroma cystica, right side of face and neck of a child fourteen months old

Fig 158 —(Case III) Patient eleven months later. Condition treated with radium

cult. I have not seen a report in the literature of the treatment of cystic hygroma with radium.

**Case IV.** Postoperative thyroglossal duct sinus injected with bismuth through the foramen cecum.—A man, aged twenty-six years, came to the Clinic because of a discharge into the back part of his throat. Eight years before, he had noticed a swelling in the middle line of the neck, and difficulty in swallowing. The lump increased in size, and was incised from the outside of the neck. During the next three years it was incised seven times. The periods of relief lasted from two to six months. Four years before, he had had a radical operation and the sinus remained healed for three and one-half months, when his throat began to swell and fill up, and he had a great deal of difficulty in swallowing and breathing. At this time another operation

was performed. At the base of the tongue, in the region of the foramen cecum, there was a small bead of thin mucopus. By means of a syringe with a long, curved tip, bismuth was injected into the small opening of the foramen cecum and a roentgenogram made, showing the tract extending from the foramen



Fig. 159.—(Case IV.) Postoperative thyroglossal duct sinus, injected with bismuth through the foramen cecum. The opening outside the neck has been closed by operation elsewhere. The patient complained of discharge into the throat. The roentgenogram taken after the bismuth had been injected through the foramen cecum demonstrated that the thyroglossal duct sinus had not been removed.

cecum forward and downward, anterior to the hyoid bone and about 2.5 cm. below it (Fig. 159). The tract was excised, and the patient recovered uneventfully.

*Comment.*—This case is of especial interest on account of the method of injecting the foramen cecum with bismuth to demonstrate the thyroglossal duct tract when the opening in the

neck had been completely closed by operation. The use of bismuth injections about the neck for determining the extent and direction of sinuses is of great value. In thyroglossal duct cysts it may determine whether the tract passes above or below the hyoid bone, and just how far it is posterior to the hyoid bone.

Recently a patient came to the Clinic complaining of a hard mass in the left side of the neck which had been present several months. On examination, a small sinus in the posterior pharyngeal wall was found. This was injected with bismuth, and the x-ray demonstrated a sinus extending from the pharynx to the cervical vertebræ. The condition was a cervical Pott's disease with a tuberculous mass in the cervical region.

Another interesting case in which bismuth injection was of value was that of a discharging sinus in the middle third of the dorsum of the tongue. The roentgenogram of the bismuth injection of this sinus revealed a very extensive cystic tumor of the base of the tongue and floor of the mouth, which was removed through a submental, submaxillary incision and proved to be a very extensive dermoid cyst. Sodium iodid, 12.5 per cent, may also be used with equal success in injecting the smaller sinuses.

## MICROSCOPICALLY PROVED SARCOMA OF THE HUMERUS

HARRY H. BOWING

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THE treatment of sarcoma of the long bones is most discouraging. Bloodgood reported a few years ago that he did not have a case of sarcoma of the upper extremity in his own series, or from the literature, in which the patient lived for more than two years. All of the patients died from metastasis to the cavity of the chest.

Meyerding reported 470 cases diagnosed sarcoma of the extremities. Of the sarcoma of the long bones, twenty-seven were diagnosed mixed-cell sarcoma, and the average length of life after operation was 22.48 months. Nine cases were diagnosed round-cell sarcoma, and the average length of life after operation was 8.6 months.

The case reported here was first diagnosed medium round-cell sarcoma, and following radium and x-ray treatments, was diagnosed mixed-cell sarcoma. Differentiation is a possibility, and is produced chiefly through the action of the therapeutic rays. The case is reported somewhat in detail, since it is a proved instance of sarcoma of the humerus, and yet the patient is living three years after the first operation. His general condition is excellent thus far. The therapeutic procedure was a combination of surgery, radium, and roentgen ray.

### REPORT OF CASE

This man, aged twenty-three years, first registered at the Clinic, November 1, 1920, complaining of pain in the right shoulder. Two years before, he had injured the right shoulder while playing football. The part remained stiff and sore for one month. About one year before, the shoulder had become pain-

ful, and there was slight stiffness at times, especially on exertion. In March, 1920, he fell on the right hand and shoulder while playing football, and the arm became very painful, sore, and stiff. A roentgenogram made elsewhere had shown an impacted fracture of the humerus, and a growth, which was believed to be sarcoma. Operation was not considered advisable by his home physicians at that time. Since the last injury there had been a dull pain in the upper arm, which at times radiated to the hand. Function had been markedly reduced,



Fig 160.—Sarcoma of the upper third of the right humerus and involving the soft parts.

only slight and limited motions were possible, and stiffness and weakness in the arm were marked.

The general examination and laboratory findings were negative except those referable to the part. In the upper third of the right humerus there was a bulging, smooth tumor, occupying the entire area. Abduction was limited to 95 per cent, but other motions were good. The tumor was slightly tender to palpation. A roentgenogram revealed a tumor in the upper third of the humerus, involving the soft tissue. A diagnosis was made of sarcoma (Fig. 160). The chest cavity was negative for metastasis. Evidently an increased absorption of bone had

occurred since March. The tumor involved the head of the bone and most of the cortex was gone. A Berger four-quarter amputation was advised and accepted.

December 3 the tumor was incised and a specimen removed for diagnosis. Much of the tumor tissue was removed, and the wound packed with gauze. Bleeding was difficult to control. Further surgical consultation decided against amputation, and radium and x-ray treatment was recommended. The pathologist reported medium round-cell sarcoma.

Between December 9 and 29, 12,062 mg. hours of radium was delivered to the tumor. Of this, 2,800 mg. hours was packed into the wound and the remainder applied to the surface of the skin. The wound drained continuously a semipurulent foul discharge, and irritation from this and from the radium rays caused an erythema to develop. The patient went home for two months, and was instructed to continue irrigations and warm moist dressings.

February 3 the patient returned for observation. The tumor had previously made a definite inroad on his health; now he was greatly improved. The operation, radium treatments, and the inevitable secondary wound infection were expected to make other inroads. The local and systemic reaction to treatment was mild. The tumor was reduced probably 30 to 40 per cent. Roentgenograms of the upper arm showed extensive destruction of the upper half of the humerus. Roentgenograms of the chest were negative for metastasis. The skin overlying the tumor was divided into thirteen areas and exposed to 13,048 mg. hours of radium. The upper, outer quadrant of the right half of the chest cavity and right supraclavicular space, and the deltoid aspect of the right arm were exposed to moderate voltage x-ray treatment. When the patient returned April 2 he said that no local or general reaction occurred following the last irradiation treatment. His general condition was very good, and he had practically regained his normal weight. Between April 2 and 8, 11,110 mg. hours of radium was delivered to the same areas as before. The anterior and posterior walls of the chest, and the right and left supraclavicular areas were exposed to moderate



voltage x-rays. The chest was divided into five equal areas anteriorly and four equal areas posteriorly, employing the cross-fire method. Coley's mixed toxin treatment was recommended, some of which was given at home. Our records concerning this are incomplete, although sufficient to indicate that it was not persisted in, and that the amount was inadequate.

When the patient returned April 28 he said that slight nausea and dyspnea occurred following his last treatments. He had been quite well since, although he had had occasional shooting pains in the right arm. Palpation never demonstrated superficial regional glandular enlargements. The sinus was draining a seropurulent discharge without much odor. Roentgenograms showed destruction of the upper half of the right humerus with bone proliferation of soft tissue. The chest cavity was negative for metastasis. The general condition of the patient was very satisfactory.

The anterior wall of the chest was divided into equal areas. The right and left axillary and supraclavicular spaces, together with the whole anterior surface of the upper arm were divided into two equal areas, and exposed to moderate voltage x-ray treatments.

May 23 the patient's general condition was splendid. The function of the right arm had been steadily increasing and was now about one-third that of normal. The sinus was still discharging, although much less. Roentgenograms were negative for metastasis. The right and left supraclavicular regions, and the right half of the wall of the chest were exposed to moderate x-ray treatments. The patient was examined July 5. The sinus in the right arm was draining as at the previous visit. The general condition was very satisfactory. Roentgenograms revealed considerable bone regeneration with cystic areas over the inner aspect, which were considered probable activity in the part. Between July 6 and 11 the skin overlying the tumor was divided into twelve areas and exposed to 10,100 mg. hours of radium. The anterior half of the chest, right supraclavicular and right axillary areas were treated with moderate voltage x-rays.

September 6 the general condition of the patient was good. The arm had ached more or less, especially in wet weather, and for the last three weeks there had been slight shooting pains in the right elbow. The aching was made worse by using the arm. The sinus discharge continued about the same in amount and character. Roentgenograms showed further bone formation. The patient has been examined in the Section on Orthopedics during each visit, and on this occasion a general surgical consultant was called in. Owing to the satisfactory result thus far obtained, it was considered wise to continue treatments and observations as in the past.

Between September 7 and 10 the skin overlying the tumor was divided into fourteen areas, and exposed to 10,496 mg. hours of radium. The same areas treated July 6 were treated with moderate voltage x-rays

December 2, 1921 the patient returned feeling well. There had been slight aching in the right arm for the last two weeks. The skin of the upper right arm, especially in the region of the sinus, had itched. There was considerable crusting, vesiculation and oozing, associated with redness of the skin. Dermatologic consultation was recommended, and a diagnosis was made of eczematoïd dermatitis. The irradiation treatments and irritating sinus discharge were considered possible causes. A 3 per cent ichthyol in zinc oxid ointment was prescribed. Between December 6 and 9 the anterior and posterior walls of the chest, two equal areas each, and the right and left supraclavicular and axillary areas were exposed to moderate voltage x-ray treatments. Roentgenograms of the arm taken in the spring of 1921 were compared with those taken in the fall, and it was agreed that the humerus looked more normal. The patient returned January 13, 1922, at which time the dermatitis had spread and was very distressing. There was a slight increase in the discharge from the wound. Further recommendations were made by the dermatologist. The patient's condition was very good; he weighed 182.5 pounds. A radium tube was placed in the sinus for eight hours. March 27 the distressing dermatitis had responded to treatment. The discharge was much less

following daily irrigations with potassium permanganate solution. Soreness had increased around the elbow. The sinus was sufficiently large to demonstrate necrotic porous bone in its depth. Roentgenograms of the arm revealed marked increased density of the upper third of the right humerus (Fig. 161) A radium tube was placed in the depth of the sinus, and allowed to remain for fourteen hours

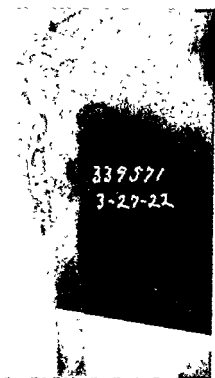


Fig. 161 —Marked increased density in the upper third of the humerus  
Soft tissue tumor greatly reduced in size

May 10 the sinus was draining a foul discharge. There was also slightly more pain in the arm, radiating into the shoulder and down into the hand. The general condition was very satisfactory. Roentgenograms of the arm did not reveal evidence of activity. Although the dermatitis was mild, the surface radiation was omitted. A radium tube was placed in the sinus for

sixteen hours. June 19 the outstanding feature was pain in the arm which had increased steadily for the last few months. The discharge from the sinus was about the same in amount, and was still foul. Roentgenograms revealed considerable thickening of the corticle with no evidence of recurrence. Irradiation was omitted. Acetyl salicylic acid, 5 gr. every four hours, was recommended to control the pain.

July 15 the pain was very severe and interfered with sleep. The sinus was increasing slightly in size. There was a foul, dirty yellow discharge. Sedatives were prescribed. No irradiation treatment was given at this time. August 21 the patient's general condition was good; he had a great deal of pain in the part which was partially controlled with remedies. The sinus was steadily increasing, and a constant foul discharge present. The orthopedic consultant felt sure that there was a sequestrum present, and recommended its removal. Roentgenograms of the chest were negative. August 22, under general anesthesia, the wound was explored and the sequestrum removed from the right humerus. All could not be removed to the entire satisfaction of the operator for fear of fracturing the bone. Further separation should occur at a later date.

The patient returned October 31. His general physical condition was excellent, and he weighed 174 pounds. The wound was discharging as at previous visits. It was irrigated with Dakin's solution, the usual technic being employed. No irradiation treatment was given at this visit.

March 21, 1923 the patient reported that the pain had been considerably less following the irrigations, but for the last few weeks it had been fairly constant, and during the last two weeks very severe. Movement of the arm brought on a very sharp pain. Certain positions afforded comparative ease. The sinus, which was evidently increasing in size, was draining a greenish-gray discharge with a very foul odor. Beneath the floor of the draining area on the inner aspect of the arm there was gross evidence of an inflammatory reaction. This was incised under local anesthesia and drained.

May 15 the patient returned with a pathologic fracture at

the site of the draining area. He did not recall having injured the part. There was gross evidence of the formation of another sequestrum. Owing to the fact that the lesion was a destructive one in the beginning, and had been modified by irradiation and the inevitable infection, it was considered improbable that a bone graft would be of much service. Conservative surgery was recommended since it has been the intention of all concerned to save the arm. It was decided to remove part of the bone which was exposed. Under nitrous oxid anesthesia a part of the humerus was excised. The pathologic report on the specimen removed was mixed-cell sarcoma.

June 28 the patient had been considering amputation. He was instructed that amputation was justifiable, owing to the ineffectiveness of conservative management. He returned home, planning to report later for operation.

August 20 there was non-union of the right humerus, and an ulcer 5 by 2.5 by 2.5 cm in depth had formed, without gross evidence of healing. The patient preferred disarticulation rather than a more radical operation. After further surgical consultation, disarticulation was decided on.

The operation was performed August 22. Ether and nitrous oxid and oxygen was the anesthetic. The tumor invaded the deltoid muscle, and this was removed with part of its attachment. The entire head of the humerus seemed to be invaded. The pathologist's report was "mixed-cell sarcoma (perithelial arrangement); extensive involvement of the upper third of the humerus, and complete destruction of bone." As a postoperative procedure, the so-called high voltage roentgen-ray technic was employed. The blood count preceding the treatment was as follows: hemoglobin 58 per cent, erythrocytes 3,900,000, color index 7+, leukocytes 6,900, lymphocytes 24 per cent, large mononuclears 4.5 per cent, transitionals 3.5 per cent, neutrophils 66 per cent, eosinophils 2 per cent; slight anisocytosis and poikilocytosis, and slight polychromophilia. Between September 13 and 16 one area of the anterior right chest wall (400 sq. cm.), one area of the posterior chest wall (400 sq. cm.), and one covering the operative field (100 sq. cm.) were exposed to the high-

voltage technic. The blood was reëxamined September 15, and the findings were as follows: hemoglobin 70 per cent, erythrocytes 4,020,000, leukocytes 8,600, lymphocytes 25.5 per cent, large mononuclears 1.5 per cent, transitionals 2.5 per cent, neutrophils 69 per cent, and eosinophils 1.5 per cent.

November 27 the patient returned as instructed for a second series of high voltage x-ray treatments, His general condition



Fig. 162 —Roentgenogram of the chest, November 11, 1923, negative for metastasis.

was very good; he was gaining in weight and strength and going to school regularly. He had noticed some pain in the amputated hand, although it steadily decreased. The tissues around the stump were sore. Near the middle of the incision there was an area with a slight discharge. The blood count was satisfactory, and compared favorably with the preceding one. Between No-

vember 28 and December 4 high-voltage technic was delivered to two equal areas, exposing the entire anterior chest wall, and two equal areas, exposing the entire posterior chest wall. This was considered the final course. A roentgenogram of the chest was negative for metastasis (Fig. 162). The first operation had been performed exactly three years before the day on which this observation was made

### TECHNIC OF RADIUM TREATMENT

The Universal silver tube applicator (walls 0.5 mm. thick), containing 50 mg. of radium element in the form of the sulphate, was used, or a brass tube of nearly equal dimensions (walls 0.75 mm. thick), containing variable amounts of the emanation, not less than 38 millicuries, and not more than 70 millicuries.

The initial treatment consisted of removing a small piece of the iodoform pack placed at operation, and placing a radium tube at the depth of the cavity over the surface of the gauze. The radium was left in place for fourteen hours. Other packing was introduced to hold the radium in position. This procedure was repeated on four occasions, the interval being two to five days. The skin overlying the tumor was exposed to surface radiation, using the following factors: one radium tube, as before mentioned, filtered through 2 mm. of lead and maintained at a distance of 2.5 cm. Balsa wood was interposed to maintain the distance. The time varied from fourteen to twenty hours. The number of areas varied from twelve to fourteen. The size of each was about 3 by 4 cm. On three visits the radium tube was placed in the depth of the draining sinus. The applications were made for eight, fourteen, and sixteen hours. The total number of milligram hours was 58.716. The date of the first radium treatment was December 9, 1920, and of the last, May 11, 1922. There is no doubt that the treatment was a factor in causing the dermatitis, and was partly responsible for the sinus formation. Very little, if any, systemic reaction occurred.

## TECHNIC OF THE x-RAY TREATMENT

In the beginning, the technic was the one usually employed, but as time went on, the time factors and distance were increased and the filtration was added to or changed entirely. The first factors were distance 30 cm., time eight minutes, milliamperage 6, filtration 4 mm. aluminium and 1 mm. leather, and spark gap 22.5 cm. The time and distance were gradually increased to distance 40 cm., time twenty minutes, milliamperage 6, filtration 6 mm. aluminium and 1 mm. leather, and spark gap 22.5 cm. The high voltage factors for the first treatment were 200 kilovolts, as measured between standard spheres; distance 50 cm., milliamperes 5, filtration copper 0.75 mm., aluminium 2 m., time one hour and two minutes. Four areas were treated. The formula for the second treatment was 180 kilovolts, distance 50 cm.; milliamperage 4; filtration copper 0.75 mm., aluminium 2 mm.; time one hour and fifteen minutes. Three areas were exposed. The local and systemic reactions were mild.

## COMMENT

The activity or rate of growth of the primary tumor was markedly reduced. Anticipating the great chance of metastasis to the chest, in view of the high mortality from this cause in similar cases, irradiation of the chest cavity was begun, even though repeated roentgenograms of the chest were negative. Just what influence the irradiation therapy had on the possible early involvement of the chest will always remain problematic. At least it may be stated that the possible metastatic process was favorably influenced.

The cooperation of the clinician, the dermatologist, the general and the orthopedic surgeon, the radiologist, and the radiotherapist made the favorable result possible. Moreover, the willingness and faithfulness of the patient are an important factor in the result. During the treatments he attended the University of Wisconsin, so that very little time was lost. Many of the treatments were given during vacation periods. Today the general condition of the patient is very satisfactory, and he





Fig 163 —The patient three years after treatment.

seemingly has an indefinite lease on a comfortable and constructive existence (Fig 163).

## PARASTERNAL DIAPHRAGMATIC HERNIA

CARL A. HEDBLÖM

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DURING the last year I have had the opportunity to observe and operate on three patients with parasternal diaphragmatic hernia.

Case I.—A married woman presented herself for examination November 9, 1922. Her chief complaint was an almost daily feeling of distention and fulness in the lower chest, particularly under the right breast. This condition had been present for about three years. On lying down she also frequently had attacks of dyspnea "as though she had just been upstairs," palpitation, and a fear of impending death. She was obstinately constipated, so that a daily laxative was necessary; catharsis and enema did not seem to give much relief. Belladonna had been prescribed without effect. During the first year of her trouble she had also had frequent attacks of abdominal pain, but following appendectomy, two years before, these had disappeared. There seemed to be no relation between the attacks and the food eaten. Soda and sal hepatica afforded some relief. Roentgenologic examinations had been made elsewhere, but with different interpretations. Diagnoses had been made elsewhere of diaphragmatic hernia, spastic colon, and hernia into the lesser peritoneal cavity.

The patient's color was good and she was slightly obese. The physical findings were essentially normal. The first roentgenogram showed gas bubbles above the diaphragm. Fluoroscopic examination following bismuth meal and enema proved the stomach to be normally placed, but a portion of the colon was high in the right pleural cavity.

Operation was performed November 13 under nitrous oxid and oxygen intrapharyngeal insufflation anesthesia. Explora-

made after her dismissal, showed expansion of the lung. She returned for examination in June, 1923. The roentgenologic examination revealed normal findings. She was practically symptom free, except for occasional dizziness and rapid pulse. An electrocardiogram revealed a sinus tachycardia (Figs 164, 165)

**Case II.**—A woman, twenty-nine years of age, came to the Clinic September 18, 1922 on account of obstinate constipation. Her mother had died at the age of thirty-four from tuberculosis. The patient had been well until seven years before, when severe pain in the back developed. Soon after she noticed a "lump" on her back. She spent most of the time during the next five years in bed, and developed an abscess and a very marked kyphosis. Nine years before coming to the Clinic she had had a cesarean section. The child is alive and well. Three years before, the patient began to be very constipated, required almost daily enemas, and sometimes in spite of enemas, went four or five days without a bowel movement. These symptoms grew progressively worse, and for the last seven months, at frequent intervals, she had gone for several days without a bowel movement, in spite of laxatives and repeated copious enemas. During such times she also had dyspnea and rapid pulse, which were much aggravated during the taking of large enemas.

At examination extreme kyphosis was evident in the lumbar region. The lower ribs lay within the pelvic brim. There was tympany over the left base, but no adventitious sounds. A roentgenogram of the spine revealed destruction of all lumbar vertebræ with marked kyphosis. A roentgenogram of the thorax after a bismuth enema showed the entire right half of the colon in the right thoracic cavity, entering through a small opening in the inner anterior portion of the left diaphragm. The stomach was found to lie below the diaphragm.

Because of the increasing kyphosis C. H. Mayo suggested fixation of the spine before operation for reduction of the hernia was undertaken. A Hibbs operation was therefore per-

formed October 12 by Henderson under local anesthesia and with very good result.

Operation for repair of the diaphragmatic hernia was performed March 5, 1923 under nitrous oxid and oxygen intrapharyngeal insufflation anesthesia through a middle line incision. Owing to the deformity, the abdomen measured only about

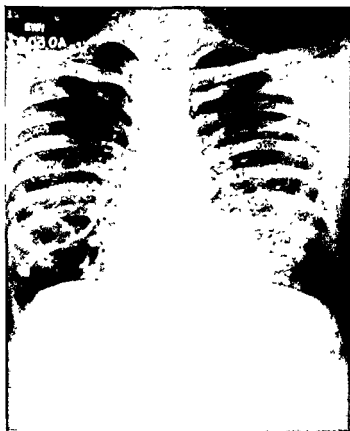


Fig. 166.—Before barium enema On fluoroscopic examination the leaves of the diaphragm appeared perfectly normal in contour and mobility.

15 cm from xiphoid to symphysis. The transverse colon and loops of small intestine were found herniated through an opening just to the left of the anterior suspensory ligament of the liver and just behind the xiphoid. By gentle traction the transverse and ascending colon, about 4 feet of the lower ileum, and all of the omentum were delivered through the hernial opening. The omentum was adherent to the hernial ring. There was

only slight suction of air into the pleural cavity. There was a continuous positive pressure insufflation anesthesia. The patient's respirations were not affected. The edges of the ring were firm and well defined, the ring being about 8 cm. in diameter. The hernia was repaired without tension by approximating the edges of the ring with two rows of double No 2 chromic cat-



Fig. 167 —Transverse colon herniated into the right pleural cavity. The hernial ring was to the left of the suspensory ligament of the liver.

gut. The peritoneal cavity was closed under only a moderate degree of tension. Convalescence was uneventful. A roentgenogram taken a few weeks after operation showed that the lung had expanded, and the thorax was normal. Since the operation the patient has rarely required enemas to secure satisfactory bowel movements (Figs. 166, 167).

Case III.—A man, forty-eight years of age, came to the Clinic in July, 1923, complaining of soreness at the right costal margin, and in the legs and neck, and of weakness. Nine years before he had injured the right upper abdomen by a hard fall against a mechanical lever. Three weeks later he had vomited blood, but did not faint. He had two subsequent hemorrhages, the



Fig. 168.—Portion of the transverse colon herniated into the left pleural cavity.

last one, three years before examination, was followed by fainting and by black stools. There was anorexia for three weeks before each hemorrhage. The soreness at the right costal arch had persisted since the injury, and was worse on jarring the body, or on exertion. There seemed to be no relation between this soreness and the taking of food. The bowel movements were usually regular. There was no dyspnea or other symptoms

each closed by two rows of double No 2 chromic catgut stitches, approximating their edges. An appendectomy was performed for chronic appendicitis. The diaphragm elsewhere was normal to palpation. The edge of the liver, particularly on the left, was of a tawny yellow, characteristic of a cirrhosis. The gall-bladder, bile ducts, stomach, and duodenum were carefully

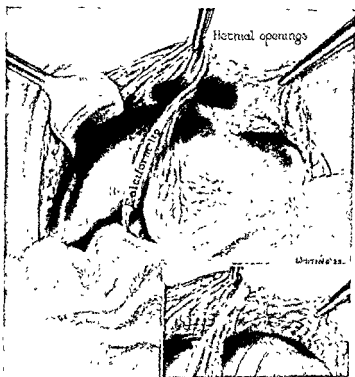


Fig. 171 —Drawing made at the time of the operation showing the bilateral hernial rings on either side of the suspensory ligament of the liver. The insert shows the edges of the rings sutured.

inspected and palpated, and found to be normal. The patient's convalescence was uneventful, and he was dismissed from the hospital on the eighteenth day. A repair of the right inguinal hernia and excision of bilateral spermatocele (Figs 168-171) was performed August 8. The patient wrote December 22, 1923 that he was back at work.

## DISCUSSION

Diaphragmatic hernia is said to be parasternal when it occurs through the triangular space devoid of diaphragmatic muscle between the attachment of the muscle to the ensiform and to the cartilage of the seventh rib (*Larry's triangular space, foramen of Morgagni*). This space, and a similar gap in the muscle posteriorly, between its attachment to the twelfth rib and the first lumbar vertebra, and the region of the esophageal hiatus, constitute the weak areas through which the so-called acquired diaphragmatic hernias usually occur.

Parasternal hernia is a relatively rare condition. I find in the available literature only twenty-four recorded cases. There are probably several more, however, among the considerable number of cases in which the site of the hernia was not definitely stated. In three of thirteen cases in which operation was performed for diaphragmatic hernia at the Mayo Clinic, the hernia was parasternal. Of 155 reported cases of diaphragmatic hernia in which operation had been performed since 1910 I find only three that were parasternal (Waller, Fitzmaurice-Kelly, and Mitchell). One hundred fifteen of these were, however, of traumatic origin, seventy-nine of which, in all probability, were due to war injuries. It differs from hernias in other parts of the diaphragm with respect to the relative frequency of involvement on the two sides, the proportion of cases having a hernial sac, and the frequency of double hernia. Toma found that in 266 cases, 223 (84 per cent) were on the left side, forty-three (16 per cent) on the right, while in only sixteen (0.6 per cent) was a sac present. Among twenty-seven cases of parasternal hernia including the three herewith reported, eight were on the left side, thirteen on the right, four were double (one of these four is reported here), and two were into the anterior mediastinum. A sac was present in twenty, and probably in most of the remaining seven in which no mention was made of it. Bowditch explained these peculiarities on anatomic grounds. He asserts that the preponderance of a right-sided parasternal hernia is due to the fact that the right pleural space is larger and nearer the middle line than the left. The liver, furthermore, does not



afford the protection against hernia to the region of the paravertebral space on the right that it gives to other parts of the right leaf of the diaphragm. Cruveilhier asserts that these hernias are of gradual onset and due to a slow spreading of the muscle columns by progressively increasing fatty deposit between the two serous membranes. Parasternal hernia does, however, occur in infancy, suggesting a congenital hernia in some cases. Three of the cases recorded were in infants, one still-born.

The symptoms produced by a parasternal hernia, as would be expected, depend on the organs that prolapse, the relative *amount of interference with their function*, and on the amount of crowding of the heart and lungs. Among the twenty-seven cases the organs found herniated were as follows:

Stomach	1
Stomach, intestines, and colon	1
Stomach, intestines, colon, spleen, liver	1
Stomach, colon, and omentum	2
Small intestine	1
Small intestine and colon	2
Colon and omentum	5
Colon	8
Omentum	4
Liver	2

At least six of the nineteen patients who died had definite symptoms of obstruction. The colon was strangulated in the hernia in four cases and the stomach in two. In one case in which the omentum only was herniated the colon was twisted on its long axis and partly obstructed. The chief symptom in this case was abdominal pain, coming on one to two hours after meals and at night. A roentgenogram showed a sharp angulation of the colon under the sternum and the bismuth enema would not pass beyond this point. In another in which colon and omentum were herniated the stomach was twisted on its long axis so that the greater curvature lay against the left anterior border of the liver. In Case I the symptoms, a feeling of distention, of fullness in the chest, and dyspnea on lying down, were chiefly due to crowding of the heart and lungs. The sensation of impending

death in this case, ascribed by her physician to nervousness, was probably a real danger signal. Many instances of sudden death are recorded in the literature, in cases in which this symptom was present. In Case II the presence of an extreme kyphosis followed by pregnancy points to increased intra-abdominal pressure as an etiologic factor. In another case of an esophageal hernia observed at the Mayo Clinic kyphosis was present. The presenting symptom in Case II was constipation, so obstinate that the patient's chief thought and energies were directed toward securing movements of the bowels. She also complained of dyspnea and palpitation, particularly after taking a copious enema. She often felt a "splashy" sensation in the thorax after taking an enema. In Case III there was a history of trauma nine years before. The symptoms which the patient said followed the trauma were of very indefinite significance, namely, soreness at the right costal margin with a history of three severe attacks of hematemesis. The history was not characteristic of ulcer, and the roentgenologic examination did not reveal ulcer.

The reports in twenty of the twenty-seven cases were based on postmortem findings. In one of the cases in which operation was performed a diagnosis was made on the roentgenoscopic examination of "congenital fixation of the colon in the region of the sternum." In one case the diagnosis was intestinal obstruction. Two cases were diagnosed on roentgen-ray examination only (Reich). In the cases herewith reported a diagnosis had been made elsewhere of diaphragmatic hernia on the roentgenologic examination. In Case III we were unable to confirm the diagnosis by roentgenologic examination, but at operation two diaphragmatic hernial rings and sacs were found. This case represents the type of spontaneous reduction in which negative roentgenologic examination does not exclude the presence of a diaphragmatic hernia. In any case in which the symptoms suggest the possibility of diaphragmatic hernia repeated roentgenologic examinations are indicated, and probably are most likely to prove the presence of a hernia if taken during an exacerbation of symptoms.

## TREATMENT

The treatment of parasternal diaphragmatic hernia is surgical repair. The relative indications for operation are greater in this than in other types of diaphragmatic hernia, if definitely diagnosed, which is usually possible by careful roentgen-ray study, because of the comparative safety of the operation and the technical ease with which repair can be effected. In this type of hernia laparotomy represents the easiest and most direct route of approach, and very little, if any, further collapse of the lung results, in the presence of a sac. The only direct indication for thoracotomy would be a large hernia with adhesions preventing reduction from below.

Even in the presence of a sac, as in the cases reported here, a positive pressure anesthesia seems of undoubted advantage if the sac is large, in that it counteracts the atmospheric pressure exerted through the sac wall on the lung. That the sac permitted such action was shown by the sucking through the hernial opening, especially in Case III. In all cases the lung was inflated to the maximum by increased intrapharyngeal pressure just before the last stitch was placed which obliterated the ring.

Of the two other patients operated on, both for obstruction, one died (Fitzmaurice-Kelly), and one made a good recovery (Mitchell). At operation Fitzmaurice-Kelly found strangulation in both sacs in one case, Mitchell found the hernia opening on the left, but the sac in the right pleural cavity, as in Case II reported here.

In all cases in which a parasternal hernia on one side is repaired, the other parasternal space should be obliterated as a prophylactic measure. I am led to this conclusion by the fact that the patient in Case II has reported, some months after operation, that she has a feeling of fulness in the left chest, suggesting the possibility of a hernia having developed in the opposite paravertebral space, and by the finding of a double hernia in the third case.

## SURGICAL ORTHOPEDIC CLINIC

MELVIN S. HENDERSON

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Left talipes calcaneus due to infantile paralysis; astragalectomy.

Infantile paralysis; varus deformity following astragalectomy.

Recent fracture of the lower third of the right femur; reduction.

Infected fracture of the left femur; removal of plate and screws.

Synovectomy for destructive arthritis of the left knee.

Congenital dislocation of the hip; reduction of left hip.

*November 15, 1923.*

Case I. Left talipes calcaneus due to infantile paralysis; astragalectomy.—We are dealing here with a calcaneal deformity, an unstable foot. Always associated with this deformity is a certain degree of hollow foot which, as will be seen, is fortunate, and no attempt is made to correct it by tenotomy or stripping the plantar fascia. The calcaneal deformity is the result of paralysis of the tendo achillis group. The relaxed tendon permits the posterior or heel portion of the os calcis to drop down, and the line of weight bearing falls so far posteriorly that the front part of the foot "flips" up and causes the instability. By removing the astragalus the whole foot is loosened up. As stability is our aim we must displace the foot posteriorly so that the line of weight bearing will fall through the middle of the foot, and thus prevent the "flip" of the front part of the foot upward. At the same time any tendency to varus must be avoided. Therefore we must clearly bear in mind three points, and see that they are fulfilled in performing this operation, or our patient may merely trade one type of deformity for another and receive no benefit. These three cardinal points are: (1) the foot must be displaced well posteriorly so that the line of weight bearing will tend to fall through

the center of the foot, (2) the foot must be placed in a little valgus, and (3) a position of slight equinus must be insisted on.

As we are working here to fulfil these conditions we find that the external malleolus impinges too strongly on the os calcis and a certain amount of remodeling of the os calcis is necessary in order that the conditions mentioned, that is, posterior displacement and slight valgus, may be fulfilled. It may be noted that we are careful to do all of our work on the os calcis leaving the smooth surfaces of the tibia and fibula intact, for if we exposed the raw bone of the fibula to the raw bone of the os calcis, ankylosis might result, whereas by this method the ankle will be movable.

We have now completed remodeling the surfaces so that correct position can be assured. The hollow foot that remains is an asset, although it may at this time appear to be a liability. When weight is borne it really will fall at the top of a curve of the hollow foot. The contracted plantar fascia and ligaments of the foot will stretch out just enough to make the foot look normal and prevent flat foot. It is not uncommon for a patient to present himself for examination some years after astragalectomy, with the foot so nearly normal in appearance that it seems impossible that such a large and apparently important bone as the astragalus could have been removed. The hollow foot is largely responsible for these excellent results.

Now that our operation is completed we must provide firm fixation or our position will be lost. We use plaster of Paris, applying it in two pieces, a foot piece and a leg piece. In children the leg piece should run well up on to the thigh with the knee flexed to a right angle, but in adults if the cast runs to the knee it will be sufficient. When the two pieces have hardened, the foot is carefully held in the position of election, posterior displacement, slight valgus and slight equinus, and the two are rapidly joined by applying plaster over the gap between the foot piece and the leg piece. The patient is put to bed with the leg elevated by overhead suspension to avoid swelling. No weight bearing is permitted for from four to six weeks, the cast being removed at the end of that time. Shoes must be provided

with a fair heel and the outer side raised to maintain valgus, and in an occasional case an inside iron and outside T strap will be required

**Case II. Infantile paralysis; varus deformity following astragalectomy.**—This boy is fifteen years old. When five years of age he had a high fever and was irrational; this is quite common in the development of infantile paralysis. The point of chief interest in this case is that the next morning the child was much better and was able to be around, but suddenly while walking later in the morning, the right leg gave way, apparently completely paralyzed. In rare cases I have known this sudden giving way of one extremity with paralysis serious enough to cause incapacity to occur without fever or illness preceding it. The history as obtained from the mother is somewhat confused, but apparently a serum was given at this time.

Under massage and other treatment the child gradually improved. An astragalectomy was performed at his home two years later, when he was seven years of age. This age is about the earliest that the operation should be performed. The result is not as good as one would wish, and it emphasizes the points that I made in the previous case of astragalectomy for calcaneal deformity following infantile paralysis

A complete muscle test of this boy disclosed the fact that from the knee up the leg is practically normal, but that there is complete paralysis from the knee down. As we examine the foot we find that in all probability the deformity is due to the fact that at the operation eight years ago the foot was not displaced sufficiently posteriorly, and was not put in sufficient valgus, or that postoperative fixation was inadequate, since the foot has developed a talipes equino-varus. The boy, although only fifteen, is five feet, eight inches tall, and weighs 203 pounds, all the more necessity for his having a good weight-bearing foot. Our problem is to correct the deformity so that he can walk with stability on the bottom of the foot. The operation consists of removal of sufficient bone from the front and outer side of the foot to permit this correction. No attention will

be paid to joint lines. The equinus is not fully corrected, for we are dealing here with a stiff ankle, the previous operation having left a fibrous union clinically approaching ankylosis. There is no history obtainable of an infection having followed the first operation eight years ago, and for obvious reasons we did not probe deeply to elicit such a history from the mother. With a slight equinus in a stiff ankle and with no varus deformity the patient will walk very well in a shoe with an ordinary heel. Our plaster-of-Paris cast is applied with the foot in the proper position, and incorporated in the cast is the canvas strip to permit suspension to an overhead frame. Suspension, as in the previous case, prevents swelling and lessens pain.

**Case III.** Recent fracture of the lower third of right femur; reduction.—This woman is fifty-two years of age. Three days ago while at work in her kitchen she fell and immediately had pain in the thigh just above the knee, with complete disability. x-Ray examination disclosed an oblique and spiral fracture of the lower third of the femur with considerable displacement (Fig. 172). The unusual part of the deformity is that the lower fragment is displaced anteriorly. In 1913 I treated this patient for destructive arthritis of unknown cause by conservative measures, that is, casts followed by braces. The result was a painless useful stiff knee. The direct bearing of this fact on the condition that we are now treating is that the stiff knee is evidently responsible for the unusual anterior position of the lower fragment and the rather rare condition of a spiral fracture in the lower third of the femur where the fracture usually is transverse. The question may well be asked, Why are we going to plate a femur in a patient past fifty years of age, particularly since the teaching today is along the lines of conservative treatment of fractures? We do not take direct issue with this teaching, but we must beware of the pendulum swinging too far in the direction of conservation. Fifteen years ago it swung too far toward operative interference. Wartime experience demonstrated nicely that firm fixed traction by aid of the Thomas splint makes excellent results possible without operation.

in cases of fracture of the femur. Our reasons for operating on this patient are, briefly: (1) that although somewhat obese and showing her fifty-two years, she is in good general condition; (2) that wearing and maintaining a Thomas splint and the constant attention it requires make it irksome and disagreeable to an obese woman; (3) that the prolonged fixation in a cast that will follow an operation need not be feared on account

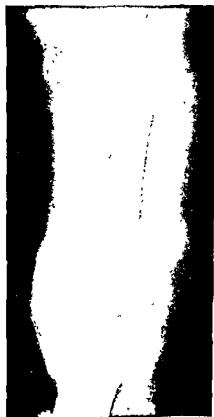


Fig. 172.—(Case III.) Spiral oblique fracture of lower third of right femur.

of the knee, for it is already stiff; (4) that the patient lives only twenty-five miles away, and for economic reasons her stay in the hospital must be as short as possible; she will be able to go home in three weeks; (5) that the risk following operation is no greater than treatment by conservative measures; we have had two deaths from pulmonary fatty embolism in cases of fracture of the femur in which conservative measures had been carried out, and (6) that it is a comfort to all concerned, and particu-



larly to the surgeon, to know that the anatomic position is perfect, and that internal fixation will hold it there until union takes place

As we make our incision and dissect down on the bone we find considerable extravasation of blood in the muscles. The lower fragment is displaced anteriorly and the upper posteriorly and inward. The lower fragment is split longitudinally so that there is a large loose fragment on the inner side. As firm trac-



Fig 173 —(Case III.) Beef-bone plate with screws holding the fracture in good position.

tion is applied with the aid of the fracture table, the fragments are seized with the bone holders and forced into line. Were it not for the split in the lower fragment with the consequent loose fragment on the inner side, we would be able to get perfect position and hold it by putting beef-bone screws through. It is apparent, however, as we are working, that an eight-hole beef-bone plate will serve better. We are maintaining our position and holding the beef-bone plate against the bone so that four holes are opposite the upper fragment and four op-

posite the lower. By using a No. 10 electric drill, we bore through the cortex and then tap the hole and put in a 10 to 24 beef-bone screw. It is not necessary to drill through both cortices. Our screws are made long enough to go through both cortices, but we cut them off to the desired lengths. Now that all the screws are placed it may be noted that we have firm fixation with an absorbable plate and screws, a distinct advantage over a metal plate. While applying the dressing and cast, all undue strain is kept off the plate. We have excellent position, as you see. We apply a plaster-of-Paris spica cast from the chest to the toes on the affected side, and to the knee on the opposite side, and can rest assured that the position will be maintained. A roentgenogram will be taken through the cast before the patient leaves the table to be sure that everything is as it should be (Fig 173).

**Case IV. Infected fracture of the left femur; removal of plate and screws.**—This man is twenty-seven years of age. Eight months ago he fell and fractured the left femur in the middle third. He was taken care of at his home, and a Thomas extension splint was worn for one month, at which time x-ray examination disclosed considerable overriding of the fragments. An open operation was performed, and according to the patient, considerable bone was sawed off each fragment; this seems to be confirmed by the three inches of shortening. The ends were brought together and held by the aid of a beef-bone plate and screws. External fixation was maintained by the aid of a cast. On removal of the cast two months ago there was motion at the site of the fracture, and there was drainage of pus from the wound. Here then is a failure of the method (in other hands, it is true) that we have just used in the preceding case. The sepsis is sufficient reason for the failure, and this, unfortunately, is a surgical liability that we all face. If it should develop in our previous case the result, in all probability, will be poor. On looking closely at the x-ray plate (Fig 174) in this case, besides the beef-bone plate and screws we see evidently a large sequestrum consisting of a portion of the entire shaft. While

there is no way of determining why this death of bone occurred, it may be assumed that interference with circulation was the cause, either from cutting off the circulation at the time of operation, or from thrombosis caused by the sepsis that followed the operation

In preparing the ends of the bone in operations of this kind the surgeon must not insist on too free a dissection back of the



Fig. 174 —(Case IV) Infected fracture of middle third of left femur, with beef-bone plate and sequestrum present

periosteum, particularly when the fracture is in the middle third, or the nutrient artery may be interfered with.

The patient came to the Clinic willing to accept an amputation; this had been the advice of his home physician. Because of his age we have urged further trial of conservative treatment to see if a functional result can be obtained. Our plan is first

to do a débridement, removing the bone plate and screws and such sequestra as are present; second, to irrigate with Dakin's solution for a few weeks with the patient wearing a Thomas splint, and third, to apply a well-fitting walking caliper while he is convalescent.

As the incision is made considerable pus appears, and deep in the wound is the six-hole beef-bone plate which we will remove. There is a large sequestrum the entire circumference of the bone and fully 7.5 cm. in length. Multiple small sequestra are also present. Having cleansed the cavity, we will provide drainage and stop hemorrhage by using a plain gauze pack and four Dakin tubes. Injection with Dakin's solution will be carried out by the drop method constantly for ten days or two weeks. Our hope is that the wound will close by granulation and that bony union will occur. We are exceedingly doubtful of the latter and quite hopeful of the former. When healing has been accomplished, walking on the caliper may possibly induce union, but if that fails, a bone-graft operation performed long after the sinuses are healed and all inflammation has disappeared from the region, should bring about union. It is rarely safe to operate under one year after all drainage has ceased.

**Case V. Synovectomy for destructive arthritis of the left knee.**—This patient is a widow, twenty-nine years of age. Her illness began three years ago with pain and swelling in the joints of the right fingers, which later extended to the shoulders, the right elbow, and left ankle. For the last six months the patient has complained chiefly of steadily increasing pain in the left knee (Fig. 175). Toward the end of the day it limbers up somewhat, but she is always lame. She has had her tonsils removed, with no benefit.

When we examine the knee we find it to be markedly swollen. The swelling is chiefly periarticular thickening, and on palpation does not give the sensation of any great amount of fluid in the joint. This swelling has been reduced to its minimum by rest in bed for several days prior to operation. We are deal-

ing here with a polyarticular infectious process in which the chief complaint now is located in one joint, in this instance the left knee. The patient's general condition is good; she is thin, but always has been. Examination of the urine was negative as was also the Kolmer test. The hemoglobin is down to 65 per cent, a certain degree of anemia being usual in such cases. Two teeth, a central and a lateral incisor, show peri-



Fig. 175.—(Case V) Destructive arthritis of left knee.

apical infection, and they are to be removed later. The *x*-ray of the left knee shows a periarticular arthritis with evidence pointing to destruction of the intra-articular structures.

Synovectomy is possible in the knee-joint to a very satisfactory degree, owing to the superficial position of the joint and the readiness with which the cavity can be exposed. Inasmuch as the knee-joint is the chief region involved in this

case, and since synovectomy would probably eradicate at least 90 per cent of the disease in that joint, I shall proceed to that operation. Most of our synovectomies of the knee for this type of infection have given very good results, producing movable,

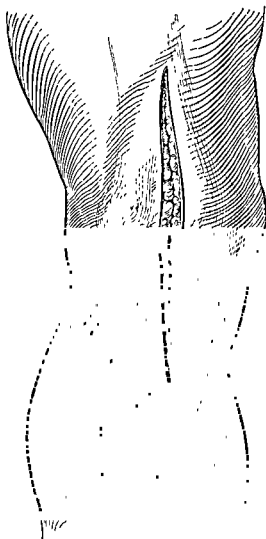


Fig. 176.—(Case V.) Split patella incision.

painless, weight-bearing joints. Whereas earlier the procedure was limited only to the more chronic cases, we have been gradually dropping into the subacute cases, this being an example.

We make a straight long incision in the middle line, carrying the dissection down into the patella, and will now, with the

hand saw, split the patella longitudinally. We excise way up through the suprapatellar pouch into the substance of the quadriceps and downward through the infrapatellar fat pad, well into the patellar ligament (Fig 176). By retracting both fragments of the patella with sharp retractors, and sharply flexing the knee, the joint is widely exposed. Both semilunar cartilages are practically destroyed, and we will remove them. The entire suprapatellar pouch, which is greatly thickened, is now dissected out along with the synovia of the capsule from both sides, but the part of the capsule in the posterior compartment cannot be thoroughly cleaned out without too much trauma. We have removed the greater part of the capsule, the semilunar cartilages, the infrapatellar fat pad and the suprapatellar pouch. The incision is closed by sewing the fibrous capsule of the patella with chromic catgut, the patellar ligament and the suprapatellar pouch with plain catgut. The skin edges are brought together with silkworm catgut and dermal sutures. A plaster-of-Paris cast is applied from the groin to the toes, with the heel well padded. Canvas suspensory strips are incorporated in the cast, so that the leg can be suspended to a Balkan frame, thus preventing swelling. In from eighteen to twenty-one days the cast will be removed and the stitches taken out. Half the cast will be left, and active and passive motion begun. As soon as pain and soreness are sufficiently reduced, the cast will be abandoned and active use encouraged. The pathologist reported inflammatory tissue, no evidence of tuberculosis being found.

**Case VI. Congenital dislocation of the hip; reduction of the left hip.**—This little patient is a baby girl, ten months old, with a congenital dislocation of the left hip (Fig 177). The teaching in the past has been that the reduction of a congenital dislocated hip is best made when the child is between three and five years of age. We have been gradually reducing this age limit, and at present are willing to operate at any age, providing the baby can be trained to keep dry. This little patient's mother is an intelligent woman, and a few days after we informed

her as to the necessity of keeping the baby dry on account of wearing the cast, brought the baby in practically broken of the diaper habit. We have made arrangements for the mother to stay with the baby in the hospital after the operation, and care for her. Certain facts brought out by x-ray studies of cases before and after operation have caused us to lower the age limit. Naturally, in order to get a good result we must begin with a well shaped and well developed head of the femur and a well developed acetabulum. We have found that, after reduction, the acetabulum, which was only fairly well developed, increased



Fig 177.—(Case VI) x-Ray of dislocated hip before reduction.

in size and depth, even before weight bearing was permitted. In other words, the head being in the socket has brought forth physiologic response, evidenced by increase in the depth of the acetabulum. It has been stated that the laxity of the tissues in the very young may permit of recurrence. It is probably true that more recurrences occur in babies of this age, but the results are excellent when reduction is maintained, and in this particular case all this has been explained and the mother is eager to have the reduction made. If it should recur later, we will have plenty of time to try again, as she said. In the older



and more difficult patients we use the Hibbs table, which aids greatly in fixing the pelvis and has the added advantage that the operator always knows just what amount of force he is using. In babies of this age, however, the table is not necessary. We employ the method used by Ridlon because it inflicts little trauma. This dislocation is left sided, so I stand on the patient's left side, facing her. My assistant holds the right anterior-superior spine down firmly, thus fixing the pelvis on that side. I grasp the left knee with my right hand and flex the thigh on the abdomen. This brings the dislocated head of the

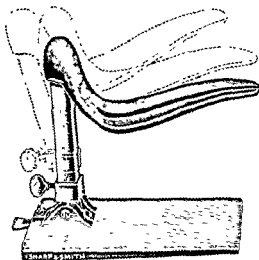


Fig 178 —Meyerding back rest.

femur down below the level of the acetabulum. I now grasp the hip between my left thumb and fingers, the latter holding the greater trochanter. I now circumduct the femur down and outward, all the time pressing upward on the trochanter; as I do so, I feel the head engage, but not quite enter the acetabulum, so I flex fully again and repeat the maneuver; this time as I press upward more on the trochanter and head, I feel the head gently slip into the socket. I now release my hold with the left hand and bring the thigh down. As it comes about half-way down there is a little jump as the head pops out of the acetabu-

lum. This assures me that we have a fair acetabulum. I again reduce the hip and raise the baby on to the Meyerding back rest (Fig. 178). Note how nicely the child rests on this adjustable sacral rest. It fits a child this age or an adult equally well. We apply a double spica cast to the knees, both legs being held in full abduction and flexed to a right angle, the so-called frog

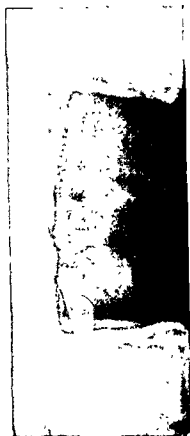


Fig. 179.—(Case VI.)  $\alpha$ -Ray of hip through cast after reduction.

position. An  $\alpha$ -ray will be made tomorrow (Fig. 179). The cast will be changed in two or three months, and at the end of six months the right leg left out, and the child permitted to walk. Eight months should be ample time for fixation. All apparatus will then be removed and the child encouraged to walk.



# ABRIDGMENT OF MAYO FOUNDATION LECTURES

WILLIAM J. MAYO

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## I. SURGERY OF THE KIDNEY

*October 12, 1923*

THE correct relationship between medicine and surgery is properly maintained in surgery of the kidney. In the Clinic, Drs. Braasch, Crenshaw, Bumpus, and Scholl of the urologic staff, aided by Drs. Carman, Moore, Sutherland, Miller, and their associates on the radiologic staff, carefully work out plans and specifications of what should be done for the patient; the surgeons carry out the surgical treatment.

All great advances in medicine have been made possible by the aid of the eye, directly, as in the examination of gross conditions, or indirectly, through the microscope and other instruments of precision. The history of the patient is, of course, extremely important, but it is by means of the eye, aided by the cystoscope, ureteral catheter, pyelogram, and radiogram, that diagnosis of diseases of the kidney, and therapeutic indications, once so difficult, have been rendered extraordinarily exact.

The day of operating blindly has passed, never to return. Today the surgeon carries out his work under the eye. In no situation in the human body has this been more thoroughly exemplified than in the surgery of the kidney. When an incision was evolved which enabled us to see and examine the kidney without permanent injury, either to it, or to the structures covering it, the most serious obstacle to successful renal surgery had been overcome.

The kidney is covered largely by the lower wall of the thorax, especially by the eleventh and twelfth ribs, which in the average person cover the upper half of the right kidney and the upper two-thirds of the left. In the early days the kidney was

often seriously injured in bringing it to the surface, except in thin subjects with large loin space. Often the twelfth rib was purposely fractured to increase the operative space. It was found, however, that by carefully dividing the structures posterior and inferior to the twelfth rib at the angle, the lower thorax could be mobilized, the pleura pushed up, exposing the kidney so that it could be manipulated safely.

The incision for operation on the kidney begins in the costo-vertebral angle behind the eleventh rib, passes downward and forward around the angle of the twelfth rib, and into the loin space half-way between the twelfth rib and the crest of the ileum, as far forward as the lateral cutaneous branch of the twelfth thoracic nerve which carries muscle-fibers. This nerve is protected as the incision is carried forward. The latissimus dorsi, the obliquus externus and internus, and the transversalis muscles are divided. The external arcuate ligament which ties the transverse process of the first lumbar vertebra to the angle of the twelfth rib, is cut and also, if necessary, the vertebral fascia. This incision does not injure the twelfth thoracic nerve running below the twelfth rib, or the ilio-inguinal and iliohypogastric nerves which run along the anterior margin of the quadratus lumborum muscle.

The fatty capsule of the kidney is next incised, and it will be noticed that the renal fat is of a lighter color than the peritoneal fat. The kidney can now be readily elevated for careful examination not only of the kidney proper, but of the upper ureter and the pelvis. In 95 per cent of cases the renal arteries pass chiefly to the anterior surface of the kidney supplying the anterior row of calices and the anterior half of the posterior row. This brings the vascular center of the kidney well behind the anatomical center. In 5 per cent of cases the opposite condition exists. In operation on large adherent kidneys the peritoneal cavity may be opened accidentally; it is usually of no consequence and should be closed by catgut sutures. Sometimes the pleura will be injured, with a startling aspiration of air into the pleural cavity during inspiration, followed at once by its expulsion in expiration, the lung can sometimes

be seen through the rent. This has happened several times in my experience, but by closing with catgut sutures and drawing a little fat or muscle over the opening I have never seen harm come from it.

It should be remembered that on the right side of the body there are two very important structures which may be endangered, the vena cava and the retroperitoneal portion of the duodenum. The right renal veins may be very short, and if the vascular pedicle escapes control, in the hurry to check the hemorrhage quickly, a rat-tooth forceps may seriously injure the vena cava or the duodenum. An artery the size of the renal springs forward during systole of the heart and can be grasped and held with the fingers until curved forceps are applied to hold it until it is tied. If the vena cava, or any other large vein is injured, it can be readily caught by the fingers and compressed, and sutured with catgut as held. It is not necessary to do more than bring the internal surfaces together and stop the hemorrhage. If necessary to check the bleeding from the stitch-holes, bits of fat may be used to act as suture compresses. Injury to the duodenum causes a fistula, and unless it is promptly closed, causes death from leakage of great quantities of intestinal fluids which destroy the cuticle of the skin and dehydrate the patient. Very often the leakage follows injuries that happen during operation, but does not become noticeable for three or four days, or until the necrotic area which has been injured, as by the forceps, sloughs. When the duodenum is injured and a fistula forms, the abdomen should be opened anteriorly, the retroperitoneal portion of the duodenum dissected from in front, and the opening sutured, and covered with omentum. The patient has recovered promptly following this procedure, in every case of this character which I have seen.

In olden times stones were usually removed from the kidney by nephrolithotomy. This was destructive to the renal substance, often resulted in painful kidneys, and sometimes set up a necrotic process which caused secondary hemorrhages at the end of a week, necessitating nephrectomy to save the patient's life. The reason for nephrolithotomy was the supposed

frequency of failure of union of an incision in the pelvis of the kidney, leading to the formation of chronic urinary fistulas. This fear is unfounded, provided the immediately adjacent fatty tissues are planted over the sutured incision in the pelvis after the removal of the stones. On one occasion, before we had developed a proper incision for operations on the kidney, in operating on a short, very stout man, I removed the stone from the pelvis, and was about to close the incision in the pelvis, when I found that the ureter had become completely separated from the kidney. With great difficulty I sutured the ureter back onto the pelvis, and surrounded it with a fatty fascial flap. There was no leakage, and the patient has been well for many years.

It is sometimes necessary to open the kidney to remove impacted stones. This may best be accomplished by opening the pelvis, passing a finger into the pelvis and elevating the stone at some convenient point as close as possible to the surface of the kidney. By this combined operation through the pelvis and renal substance the stone is removed with the least possible damage.

Stones in the kidney not infrequently are overlooked at operation, sometimes because they are buried deep in the calix or in the renal substance. Sometimes the x-ray will not show *all the stones because one is superimposed on another*. In several instances in the Clinic all of the stones have supposedly been removed, yet radiograms taken before the patient left the hospital revealed stones that had not been detected. Drs. Braasch and Carman have developed a fluoroscopic technic for use at the operating table which has been of the greatest aid. The examinations are made at intervals during the operation and the location of stones pointed out, and finally, before the operation is completed, it is demonstrated that no stones remain.

From Tuffier of Paris, about twenty-five years ago, I learned how properly to remove pus kidneys. At that time the mortality following nephrectomy for pus kidney in this country was above 25 per cent. I remember well my sensation on seeing Tuffier split the fibrous capsule and shell the kidney from

the protective adhesions which nature had so carefully erected, and which we had so short-sightedly attempted to remove in toto. In 1914, in Petrograd, Federoff showed me a very clever addition to the subcapsular method. Elevating the decapsulated kidney, he divided the capsule, which was turned back over the pedicle, completely around, close to the sinus of the kidney, which made it possible to pull the kidney and its vessels through the enveloping capsule, and the vessels to be ligated directly. In ligating large vascular pedicles by the clamp method, two clamps should always be placed on the proximal side, so that the pedicle may be safely held by the distal clamp, while the first ligature is placed in the groove as the deeper clamp is removed. The second ligature makes the safety tie as the outer clamp is released.

When a large tumor of the kidney exists, especially so-called hypernephroma, which is a true tumor of the kidney, not related to the adrenal glands, a transperitoneal incision should be made anteriorly through the semilunar line, the colon on the affected side dissected forward, and the renal vessels exposed and tied, as the first step of the nephrectomy. This prevents mechanical distribution of polypoid growths, which may project into the veins, from being forced into the general circulation. The ureter is then tied, and divided with the cautery, the tumor dissected out, and the space closed without drainage.

## II. THE SPLEEN

*December 11, 1923*

The blood may be considered to be an organ consisting of cellular, colloid, and crystalloid substances in a liquid medium, and the vascular system a means of transportation which carries these various substances to the tissues of the body and removes waste products. The total volume of blood in the body of the average person is estimated by Mann at from one-thirteenth to one-tenth of the body weight. Krogh and Haldane have shown that in man at rest each cavity of the heart expels about 4 liters of blood a minute. Under violent exertion, to supply the necessary amount of oxygen to the tissues, the entire volume of blood



passes through the heart and around the body every ten seconds, and the amount expelled by the heart each minute is increased from 4 to 24 liters.

The vital constituent of the blood is oxygen. The supply of oxygen to the extremities can be cut off safely, even for several hours, but if the circulation of the blood through the central nervous system is stopped for more than from seven to ten minutes, death ensues. When there is shortage of oxygen from actual hemorrhage, the blood-pressure drops and the efforts of the heart and the respiratory system are increased to hurry oxygen to the tissues. By the rapid action of the circulatory and respiratory systems the carbonates in the blood are thrown out as they would be in normal respiration, and the rapidity of respiration tends to their exhaustion. Seventy-five per cent of the human body is water. Filling the veins with saline solution to increase the blood pressure in shortage of oxygen from hemorrhage is of no benefit, for the red cell oxygen carriers are not increased, although their medium is diluted, nor is the blood volume materially increased, because the water will not stay in the blood vessels. Transfusions of blood, which add to the oxygen-carrying capacity, are indicated in serious hemorrhages and in the anemias.

Just how much a single transfusion of blood will raise a lowered blood-pressure is still under discussion. Taking the hemoglobin as an index, a reasonable transfusion, from 500 to 600 c.c. of blood, cannot be expected to raise the hemoglobin index more than from ten to twenty points. Repeated small transfusions, on the whole, give better results than a large single transfusion, provided the first transfusion is sufficient to maintain life.

If the cause of oxygen shortage is overexertion, causing sudden failure of the mechanisms of circulation and respiration, as in an acute dilatation of the heart, the rapid elimination of carbonates, which accompanies fatigue, and failure to eliminate the products of combustion, tend to produce an acute acidosis. In such cases there are plenty of oxygen carriers, but temporarily too little oxygen and too little carbonates, which prevents the trans-

formation of the accumulated waste into carbon dioxide. Transfusions of blood would be harmful, but phlebotomy may be indicated to relieve the circulation and prevent a breakdown of the transportation system.

The spleen acts as a mechanical filter, removing from the blood substances above colloid size, such as protozoa and bacteria, which it sends to the liver for destruction. The spleen is most important in its relation to the three cellular elements of the blood: the red cells, the white cells, and the blood platelets. The spleen is a hemolymph gland belonging to the reticulo-endothelial system, and its chief function is the destruction of the deteriorated red cells. When the spleen is enlarged from any one of many causes, it destroys an excess of red cells, and this action, though not necessarily the primary cause of the pathologic states with which it is associated, is closely connected directly or indirectly, with many of the chronic anemias. Splenectomy does not necessarily eliminate the underlying cause of the disease, but in removing the destructive agent it often renders the disease ineffective.

Splenic anemia, the most common of the splenomegalias, is a syndrome of many causes. As the etiologic agents are discovered, the splenomegalia takes the name of the cause, as in syphilis, in which, besides the evil effects of the spirochete, the enlarged spleen has an effect on the red cell similar to that of splenic anemia. Hemolytic icterus is another syndrome in which the spleen acts as a destructive agent, and which is quickly cured by removal of the spleen.

In certain cases of pernicious anemia the spleen, while an incident in the disease, is unduly destructive of red corpuscles which, while deteriorated, are capable of carrying on life, and are the best the patient can produce.

The enlarged spleen is more closely connected with polycythemia than has been believed. Splenectomy in the terminal stage of polycythemia has resulted in extraordinary improvement in the condition of one patient in the terminal stage, an improvement which has lasted more than two years.

In purpura hæmorrhagica the spleen acts as a destructive

agent of the blood-platelets, and when these are reduced from the normal of between 225,000 and 300,000 to below 40,000 hemorrhages of the purpuric type take place, and the bleeding time is greatly prolonged. Chronic cases of this description are quickly cured by splenectomy.

Spleno-myelogenous leukemia is marked by an overproduction of lymphocytes in the spleen. The reduction of the size of the spleen by radium, followed by splenectomy, in selected cases has led to prolonged improvement, and a few splenectomized patients are alive more than five years, although their blood is not normal.

### III. CANCER OF THE STOMACH

*December 18, 1923*

The incidence of cancer of the stomach is large, comprising about one-third (36 per cent) of all cancers. Why is this condition so common in man? It is not common in animals nor, so far as we know, in primitive man. It is possible that certain habits of civilized man lead to the development of cancer of the stomach. Various hypotheses have been advanced in explanation. Heat may be a factor. It is well known, of course, that animals and primitive man do not use hot food and drinks. It is also known that there is a connection between certain highly specialized types of cancer and applications of heat. I recall cases of railroad engineers who had cancer of the skin over the shin. Engineers are exposed to intense heat as they stand in front of the fire box of the engine. Certain dwellers in the mountains of Asia and Turkestan carry braziers of burning charcoal, resting them on the abdomen. A type of surface cancer is so common among these people that it takes its name, kangri, from the charcoal container. There is a greater incidence of cancer of the pharynx among Chinese men than Chinese women. Here again heat is a possible factor, for the men are served first, and eat their rice while it is very hot, tossing it into the mouth with chopsticks, so that it strikes the back of the throat. The women, who have to wait, eat cooler food. The average person swallows tea and coffee much hotter than it can be comfortably borne

in the mouth, which may be a factor in the causation of cancer of the stomach. We know that cancer is often the result of chronic irritation, and undue heat, by producing irritation, may give rise to cancerous growth.

Roentgenologists find that when the stomach is partly full the fluids do not necessarily drop down with the rest of the contents, but, because of the peculiar formation of the stomach, pass along the lesser curvature almost directly into the duodenum, where ulcer and cancer are commonly found. Thus it may be noted that the most common site of cancer is in the line of canalization of the stomach, along the lesser curvature. So far as the location of cancer is concerned, it is nearly identical with that of ulcer, *except that ulcer is more common in the duodenum than in the stomach.* It is interesting also, in this connection, that in men the first portion of the duodenum is ascending. In women it is very often transverse instead of ascending; therefore, in women, the bile and alkaline juices tend to rise much higher toward the pyloric end of the stomach than in men. The point at which epithelium changes, as at the pyloric orifice of the stomach, is not so often the site of cancer as was formerly believed; the site is usually higher.

The acids of the stomach are produced perhaps to a larger extent in the fundus than in the pylorus; they are not produced by any gland in the body of the stomach. The chemicals which make up the hydrochloric acid of the stomach are produced in the crypts of the glands, and are brought together on the surface of the acini, where the acid is formed. As a rule there is no free acid in the stomach in cases of cancer and in many cases of ulcer. Eusterman has reported a large number of cases of typical gastric and duodenal ulcer without acids. It is problematic how much the acids have to do with the formation of ulcer. If the large intestine is free from bacteria, the secretions are alkaline, as in other parts of the body.

You are all familiar with the means of diagnosis. Diagnosis depends on the history, the x-ray, and examination of the gastric contents, especially as to the presence of food remnants, and other indications of obstruction. The x-ray has ac-

accomplished much in extending the power of the eye. An x-ray picture is not the likeness of an object, but of the object's shadow, and is comparable to silhouettes. I have known of a few instances of death from hemorrhage from cancer of the stomach, but it is rare. Occult blood is nearly always present in the stool, but one can only guess where it comes from. In earlier days we operated only on patients with obstruction. We gave them a few raisins at night, and in the morning, if the skins were in the stomach, we were sure there was obstruction.

Various factors determine the operability of cancer of the stomach. When I first began operating for this condition it was generally believed that a palpable tumor was inoperable. This belief has since been proved to be untrue. It has been our experience in the Clinic that movable tumors are usually in the pyloric end of the stomach, which suggests early obstruction. From the surgical standpoint the pyloric end is the removable part of the organ, and if a tumor is movable it may be removable.

Tumors of the body of the stomach and of the lesser curvature are not so favorable for operation; yet large tumors on the lower part of the stomach may prove to be of the fungating type, the so-called cauliflower tumor, which may be successfully removed. My father used to say that whenever a cancer came toward him, in examining a patient, it was favorable for operation, but that when it pointed inward, it was unfavorable, meaning that any type of fungating tumor, although more liable to metastasis through infected thrombi, could be more successfully treated by surgery than the contracting type.

Broders has shown that the more differentiated the cell, and the more it resembles the normal cell, the less the degree of malignancy; and the more it differs from the normal cell, the greater the degree of malignancy. The cell is all that there is of cancer. The stroma surrounding the malignant cell is the fortification with which nature tries to surround and encapsulate the invading cells, and it is the measure of nature's resistance. Broders has been able to determine, by examining tumors many years after removal, the probable end-results, and in certain types of

cancer the prognosis could be predicted with accuracy. This work is important since the possibility of cure depends not only on the movability and removability of the growth, but also on the character of the growth, especially in relation to the resistance of the patient.

Cancer of the stomach spreads in four different ways: by direct extension, by grafting, through the lymphatics, and through the blood stream. We know that when the lymphatics are not involved, operations in suitable cases give good results, 71.8 per cent of patients recovering and remaining well following operation, whereas, if the glands are involved, a little more than 19 per cent of patients are cured. If, in cases of cancer of the stomach, metastasis has extended to the glands in the supra-clavicular fossæ, the condition is incurable. If in doubt as to the involvement of the glands, one can remove a gland under local anesthesia for examination. Another indication of inoperability is metastasis to the umbilicus, resulting in the "button" umbilicus. This can be proved by removing a specimen for microscopic examination. It is always a misfortune to operate in a hopeless case, and in a case of this type there is no excuse for it.

The dissemination of cancer through the body by grafting is particularly common in cases of cancer of the stomach. A considerable percentage of cases of cancer of the ovary are secondary to cancer in the upper part of the abdomen, most often in the stomach, and occasionally in the gallbladder. Cancer cells, whenever they involve the peritoneum, begin to shed; they drop down on to the ovary, which, following menstruation has a raw surface, and affords opportunity for grafting. Often cancer cells lodge on the anterior portion of the sigmoid at the bottom of Douglas' pouch. Blumer has given the best description of this process as a rectal shelf. In both male and female the condition must be detected by digital examination. Giffin says that every general examination should be begun by an examination of the rectum.

The study of the metastasis of cancer reveals interesting problems. It has been shown that, with the exception of the organs

of the gastro-intestinal tract, nothing enters the capillaries of the veins except particles molecular in size, and soluble in water. For instance, colloid size, from 1/10 to 1/1000 micron, is too large to enter the capillaries, and particles this size are picked up by the lymphatics.

Carman, Moore, and their co-workers are at the hospitals every morning to watch operations on patients whose condition they have diagnosed by the x-ray. As a result of this first-hand correlation of x-ray and operative findings, they have increased the percentage of accurate diagnoses to about 95 per cent, and even greater accuracy is anticipated.

With one type of tumor high on the posterior wall of the stomach, the patient may have almost no symptoms, except anemia. The tumor does not produce obstruction, and is not palpable. As a result, the condition is commonly overlooked until it has reached a stage which is inoperable. Diagnosed early, these are not necessarily hopeless cases. In twelve cases in which I removed all, or nearly all of the stomach, the patients all developed persistent anemia following operation. One patient has lived seven years and has the appearance of a person with pernicious anemia, but not the characteristic blood picture. He has been able to work and to support his family. Cancer of the stomach in the very anemic patient with a tendency to edema gives a large operative mortality, but cancer of the ascending colon, producing exactly the same symptoms, is favorable for operation.

The question of curability of cancer depends on many factors, the first of which is the location. Hedblom successfully removed the lower 2 inches of the esophagus and the proximal half of the stomach, a really great surgical feat. The technic of such an operation is so difficult, the operation itself so dangerous, and the chances of success so small, that it is questionable whether this operation will be commonly performed. The procedure of removing parts of the movable stomach for cancer is now well established. We have a number of patients living and well ten or fifteen years after partial gastrectomy. Cure depends on operating early.

The palliative effect of operation in hopeless cases of cancer is to be considered. I remember very well a patient on whom I operated about twenty-five years ago. I found what I thought was a hopeless case of cancer of the stomach. This was before the removal of specimens for examination of frozen sections had been introduced. I closed the wound, following exploration, and in due time explained to the man and his family that there was no help for him. He went back to work for fourteen months, but eventually died from cancer. Exploratory operation sometimes temporarily stimulates a greater peritoneal resistance.

Kocher found that gastro-enterostomy in cases of cancer of the stomach gave the patient about five months' extension of life. If the patient has no obstruction, gastro-enterostomy will be of little value, but if he has obstruction he will get enough relief to make it worth while. Partial gastrectomy in suitable cases gives excellent results.

Mikulicz pointed out the palliative possibilities of gastrectomy. He demonstrated that a patient whose stomach was resected for cancer lived about fourteen months or longer, and finally died after a short, painless illness from internal metastasis.

Four or five years ago I operated in twelve cases of hopeless cancer of the stomach, performing a gastrostomy. I inserted a tube and fastened it in such a way that it lay in contact with the cancerous process, and then applied radium to the growth through the gastrostomy tube. I was very much disappointed that none of the patients lived more than a year.

Jejunostomy has a field of usefulness in cases of cancer of the stomach, and also in huge ulcers. Possibly we perform this operation in the Clinic rather less often than we should in these cases. The operation prolongs life, and the patient gains in weight.

Palliative operations, even if there are tumors in the liver, may be worth while. A patient came to us, a tuberculosis specialist, because of stomach trouble. A diagnosis of cancer of the stomach was made, and proved by the x-ray. Nodular tumors were also palpable in the liver. The patient requested



that the growth be removed from the stomach despite the complications in the liver, for he had found that, in cases of tuberculosis if he could cure the original lesion, he had a better chance of controlling the secondaries. I operated on him, and he lived and worked for three and one-half years. The liver was rayed at regular intervals. Later he returned with a huge mass in the liver; he had lost considerable weight, but had no pain. He died six months later, but he had had an additional four years of life. Dr. C. H. Mayo has observed a similar case.

The Billroth 1 and 2, the Polya, and the Balfour-Polya methods of partial gastrectomy all have their special fields of usefulness. Decision as to the best procedure cannot always be made until surgical exposure makes accurate examination of the lesion possible.

The death rate following operation in cases of cancer of the stomach depends largely on the type of cases accepted. Following radical operations for cancer of the stomach a 10 per cent mortality is, I believe, justifiable and affords a just operability

## THE SURGICAL RISK OF THE DIABETIC PATIENT

S. FRANKLIN ADAMS AND RUSSELL M. WILDER

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It was but a few years ago that the hazard of the diabetic patient who required surgical treatment was prohibitive. Mortalities of more than 30 per cent have been reported, but, little by little, with an increasing knowledge of diabetes and of means to control it, the chance for successful outcome has improved, and today the patient with diabetes who requires an operation may be placed on an equal footing with the patient who has no metabolic defect. A few years ago one of three diabetic patients died following operation; today only one of sixty-three die. Such control of the surgical risk of diabetic patients has been accomplished in the Mayo Clinic by attention to three factors: surgical technic, wisdom in choice and administration of anesthesia, and sufficient attention to the medical features of every case. Had one of these factors been wanting, such results could not have been achieved, despite the fact that insulin was available during the latter half of the period under consideration. In 327 operations performed on 251 diabetic patients between October 1, 1921 and October 1, 1923, there were four deaths, none attributable to acidosis. One hundred forty-one operations were classified as major; among these were ninety-five abdominal. The mortality percentage for all operations was 1.2 per cent; for major operations, 2.8 per cent; and for abdominal operations, 4.2 per cent. These percentages compare favorably with the general mortality rate of the total number of operations performed at the Mayo Clinic. Tables 1 and 2 reveal that the number of severe operations on the diabetic patients was fully as great as is usually encountered in any general surgical practice.

TABLE 1

MAJOR OPERATIONS PERFORMED ON DIABETIC PATIENTS BETWEEN OCTOBER 1,  
1921 AND OCTOBER 1, 1923

Type of operation,	Number of cases
Thyroidectomy	26
Cholecystectomy	18
Appendectomy (one perforated appendix*)	13*
Cholecystostomy	8*
Herniotomy	7
Amputations (for gangrene)	7
Colostomy	7*
Breast amputation	5
Nephrectomy	5
Removal of adnexa	4
Exploration (abdomen)	4
Posterior gastro-enterostomy	4
Prostatectomy	3
Mayo operation for prolapse	2
Cystotomy	2
Partial resection of bladder	2*
Hysterectomy	2
Mikulicz	2
Posterior resection of sigmoid	2
Knife excision of gastroyejunal ulcer	1
Tubo-ovarian abscess	1
Block dissection of glands of neck	1
Complete mastoidectomy	1
End-to-end anastomosis	1
Cautery excision of ulcer	1
Excision of diverticuli of bladder	1
Knife excision of ulcer (gastric)	1
Ureterolithotomy	1
Excision of fascia of both submaxillary regions	1
Thoracoplasty	1
Removal of ovarian cyst	1
Drainage of pancreatic cyst	1
Removal of cyst of omentum	1
Vaginal hysterectomy	1
Myomectomy	1
Radical dissection of both groins	1
Resection of rectum	1
Total	141†

\* One operative death

† Total deaths 4.

TABLE 2

MINOR OPERATIONS PERFORMED ON DIABETIC PATIENTS BETWEEN OCTOBER 1, 1921 AND OCTOBER 1, 1923

Type of operation.	Number of cases.
Alveolotomy..	80
Tonsillectomy	39
Extraction of cataract	5
Cautery to cervix, perineorrhaphy, D and C	4
Aspiration of chest	4
Amputation of toes (for gangrene).	4
Antrum window	3
Specimen from cervix	3
Fissure in ano	2
Nasal polyps	2
Umbilical hernia	2
Bovée	2
Perineorrhaphy	2
Circumcision	2
Abdominal paracentesis	2
Transplantation of pterygium	2
Drainage of chronic empyema of chest	2
Hemorrhoidectomy	1
Epithelioma of nose (excision)	1
Exploration of humerus for osteomyelitis..	1
Lipoma of right thigh ..	1
Trephine for glaucoma	1
Cervical polyp	1
Bilateral lipectomy	1
Excision of anterior lip of cervix	1
Cautery excision of papillæ of rectum	1
Orchidectomy	1
Removal of great toe nail	1
Removal of sequestrum from great toe	1
Excision of fistulous tract.	1
Excision of rib segment..	1
Removal of cyst of face	1
Excision of carbuncle	1
Bilateral bunions	1
Cervical polyps	1
Fibrolipoma of forehead	1
Removal of nerve of supra-orbital region	1
Postanal dermoid	1
Parotid tumor	1
Plastic operation on sphincter..	1
Removal of fibrous abdominal wall	1
Dupuytren's contraction repair..	1
Artificial pneumothorax.....	1
Total.	186*

\* No deaths.

A large factor in securing these results has been a continuation of the responsibility of the internist throughout both the medical and surgical periods of the patient's stay in the hospital. In the average hospital the medical and surgical services are sharply divided, and when a patient is transferred to the surgeon the internist's responsibility ceases. Consequently, an intervening period of neglect occurs, the length of which will depend on the time necessary for the new administration to take hold. It is much like swapping horses in midstream and is particularly hard on the patient, because it occurs just at the time of the greatest danger, that of the operation itself. The surgeon must assume supreme command from the time the patient enters the operating room, but this does not require or imply that the internist should relinquish his responsibility, and, in the Mayo Clinic, the surgeon has always welcomed the expert assistance thus assured him. In the same connection might be mentioned the better results secured in the management of goiters by Plummer and Pemberton, in part attributable to a similar plan.

As important as insulin, if not more so, has been the care and precision of preoperative treatment. Each patient requiring surgery is referred to the diabetic service at St. Mary's Hospital for preparation. He is made ready as rapidly as is consistent with safety and the surgical indication. Complete freedom from acidosis is most important, and during the two or three days immediately preceding operation, the diet contains 100 gm. of carbohydrate, enough insulin being used to accomplish its assimilation. It has been pointed out by many observers that patients with an adequate sugar reserve withstand operation and anesthesia better than those whose sugar reserve is low.

Following the operation, 900 c. c. of fluid is given every six hours by mouth, unless surgically contraindicated, otherwise by proctodysis, or subcutaneously. Heart stimulants are used if the pulse-rate is above 100, or if any evidence of cardiac weakness appears. Each specimen of urine, voided or catheterized, is examined for sugar and diacetic acid, and estimations of the blood-sugar and the carbon dioxid combining power of the plasma are made at frequent intervals. Glucose and insulin are ad-

administered in doses sufficient completely to control acidosis; the glucose is given by any avenue as may be necessary, and for each gram of glucose one unit of insulin is injected subcutaneously. The control of hyperglycemia and glycosuria seems to be of minor importance during the critical days after operation. When the diet is re-established, mixtures of food are prescribed which take into consideration both the surgical and medical features of the particular case. Gradually, as the patient convalesces, he is brought from fluid to solid foods and his total caloric intake is increased to the amount he was metabolizing before operation.

As a result of this management, the extreme postoperative acidosis, formerly so common, does not occur. In case of such acidosis, the result of improper preoperative care, we would not hesitate to employ an intravenous injection of 500 c.c. of a 6 per cent sodium bicarbonate solution in order to obtain an effect more immediate than is obtainable with insulin. A case is cited herewith which illustrates the value of insulin in connection with surgery when properly used.

### ILLUSTRATIVE CASE

A woman, aged thirty-seven years, came to the Clinic March 20, 1922, with acute, severe diabetes of nine months' duration. Her glycosuria was controlled with difficulty. The patient was instructed with regard to the examination of urine, and the calculation of diet, and returned home. She came back to the Clinic in December, 1922, and was placed on insulin and a diet sufficient for her needs (carbohydrate 22%, protein 54, and fat 16%). The urine was kept sugar free on this diet with the help of 20 units of insulin. Progress was satisfactory until August, 1923, when for seven days the patient's bowels were completely obstructed. Her tolerance for sugar immediately dropped to a very low level. On the eighth day a bowel movement was secured. She developed a temperature which fluctuated between 99° and 101° F. At this time she was seen at her home by a member of the Clinic staff, who discovered a fluctuating mass, 10 cm. in diameter, to the left of the uterus. She was brought to Rochester, and a posterior colpotomy performed, which was unsuccessful. The condition was grave. If a major operation were not performed at once, it was feared that the patient would soon die as a result of her diabetes, and if it were performed, it would involve a tremendous risk because of the severe diabetes. At this time 75 units of insulin were required daily to control acidosis. Laparotomy was decided on and a huge tubo-ovarian abscess was disclosed, adherent to the rectosigmoid. Adhesions were so dense that the surgeon could not remove the whole mass

without making a small opening in the rectum. The unavoidable soiling of the peritoneum was regarded as serious, otherwise the operation was uneventful. At six- to twelve-hour intervals for five days, beginning immediately on returning to her room, the patient received 25 gm. of glucose intravenously, and 25 units of insulin subcutaneously. It was imperative to introduce sugar in this manner, because the purely surgical features of the case contraindicated giving anything by mouth or by rectum. From a surgical standpoint

After the sixth day it was usually she attained her former

The removal of the abscess was followed by a considerable gain in her tolerance for sugar. At present, except for her diabetes, which is kept under control with a weighed diet and proper insulin dosage, she is in excellent health.

Gratifying results are obtained by the use of insulin in cases of surgical gangrene. The gangrenous extremities of diabetic patients formerly demanded high amputation; now a more conservative operation can be performed. In some cases insulin has even seemed to favor healing when the gangrene has not been too deep nor too wide-spread.

### ILLUSTRATIVE CASE

A man, aged seventy-five years, with a seven-year history of diabetes, came to the Clinic with gangrene of the outer and superior aspect of the great toe, extending back to the metatarsophalangeal articulation which was infected, but not foul-smelling. This man asked to have every possible non-surgical measure tried. He was, therefore, kept at complete rest, alcohol dressings were applied, and a weighed diet and insulin injections were instituted. Healthy granulations soon appeared at the margin of the gangrene. Little by little it was possible to remove small pieces of dead tissue, underneath which normal granulating areas were disclosed. The distal end of the terminal phalanx showed evidence of osteomyelitis, and it was therefore removed on June 12. The patient left the hospital June 17 and continued his plan of treatment at home. October 4, when he returned, his toe was entirely healed. In this case every effort was made to maintain the urine free from sugar, however, the lowest blood-sugar reading recorded was 160 mg. for each 100 c.c.

In conclusion, we should like to comment on the fact that the measures recommended for the diabetic patient who is to be operated on have not only reduced the death rate, but have affected favorably the incidence of postoperative complications. Wound healing in these cases has been entirely satisfactory, and respiratory infections have been limited in the extreme. Such

results suggest that similar intensive care, if applied to patients without diabetes might appreciably lower the general operative mortality rate. The value of light anesthetics and short operations, and careful appraisal of each patient for a few days, preoperatively, are emphasized. Trivial infections, such as head colds, may thus be appreciated and allowed to disappear before operation. Carbohydrate feeding, preoperatively, is probably of value; preoperative starvation, as occasionally practised, is probably dangerous. Postoperative acidosis should be recognized immediately and treated with glucose, or with glucose and insulin.

Finally, one point will bear reiteration. The diabetic patient who undergoes an operation today is just as great a risk as ever. It is inexcusable, therefore, to expect that one or more injections of insulin will serve to offset any bungling, either in the surgical or in the medical management of the case





# THE SURGICAL TREATMENT OF INFECTIOUS ARTHRITIS

WALTMAN WALTERS

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DURING the last six months we have been able to relieve the joint pains and swellings of three women suffering from infectious arthritis. All of these patients had had all possible foci of infection around the nose and mouth removed without the slightest relief of joint pains. Each of them was married, had one or more children, and had a lacerated eroded cervix uteri and leukorrhea. Because of the recent experimental work of Moench, who produced joint infections in animals following the intravenous injections of material obtained from the walls of amputated cervixes from patients with infectious arthritis, it seemed justifiable, as a last resort, to remove the cervix from these patients.

In high amputations of the cervix, a small portion of cervical tissue is likely to be left attached to the uterus, thus defeating the purpose of the operation. Consequently, inasmuch as a vaginal hysterectomy can be performed in uncomplicated cases with a mortality of less than 1 per cent, it seemed best to adopt this method of removing the cervix in toto. The patients left Rochester three weeks after operation, absolutely free from joint pains. The joints, especially of the fingers, had diminished in size. Limitation of motion of the fingers had diminished to such an extent that they were able to use their hands efficiently, which, previously, as a result of the arthritis, had been almost useless.

The first patient was a woman, aged fifty-six years. She had had two children; the menopause occurred when she was forty-five. She had had pain in the back, left shoulder, and arm for fifteen years. Three years before tonsillectomy had been performed following an attack of tonsillitis; the rheumatism

was not benefited. Six months later a thorough roentgenologic examination was made, with the hope of finding the focus of infection. Eight months before coming to the Clinic she had an acute attack of pain in the left shoulder, so severe as to require morphin for a week. The shoulder had swollen and inflamed, temperature was 101°. This condition lasted three or four weeks. For the last year the patient had complained of stiffness of joints, worse on arising, and improved by use

Examination demonstrated limitation of motion in the left shoulder in all directions except adduction. The tonsils had been cleanly removed. x-Ray examination revealed hypertrophic osteo-arthritis of the spine, and multiple diverticuli of the sigmoid, ascending colon, and hepatic flexure. Vaginal hysterectomy was performed by W. J. Mayo for septic cervicitis. Pathologic examination showed a uterine polyp, 8 mm. long, and chronic cystic cervicitis with marked sclerosis of vessels.

The second patient was a woman, aged forty-seven years; she had had one child, with difficult labor. Curetage had been performed and the cervix repaired in 1913, tonsillectomy had been performed in 1917, and all the teeth had been removed since then. The finger-joints were swollen, and for the last three years the patient had had attacks of chronic infectious arthritis. In August, 1922 the phalangeal joints became reddened and swollen, and in November and December the patient was practically bedridden because of severe pain in the hips, feet, and hands.

Examination revealed marked psoriasis over the abdomen, trunk, arms and head, and deformities of the finger joints, and joints of the wrist and feet, with variable limitation of movement. The cervix presented a roughened surface. A vaginal hysterectomy was performed September 29, 1923. Pathologic examination revealed chronic cystic cervicitis with erosion.

The third patient was a woman, aged sixty-six. She had had two children. The menopause occurred at fifty-four. She came to the Clinic because of chronic infectious arthritis. Following an attack of the flu in September, 1922, the joints in the hands had become swollen and painful, and the condition

gradually extended to the elbows, shoulders, neck, knees, and feet. The teeth and the tonsils had been removed, but pain still remained in the joints of the hands and the left foot; these were slightly deformed. The patient said that the pain moved from joint to joint. A diagnosis of chronic infectious arthritis was made. A vaginal hysterectomy was performed August 27, 1923, because of chronic cervicitis. The cervix was fibrous and the external os eroded. The pathologic report was chronic cervicitis.

### DISCUSSION

That an abnormal cervix may harbor organisms in its walls that become foci of infection is not a new idea. The work of Curtis on this subject is important. The structure of the cervix, with its corrugations and folds of mucous membrane, containing deep-seated racemose glands with tortuous canals, the mouths of which are easily plugged with mucus, affords harbors for the retention of bacteria. Langstroth established the fact that chronic infection of the cervical mucosa with pathogenic bacteria is common, and that if it becomes a focus of infection, it is prone to cause systemic manifestations, as do foci in teeth and tonsils. Indeed, because of the distribution of the cervical lymphatics which form a basis for an extensive ascending infection of the pelvic structures, Sturmdorf gave it the name of cervical tonsil. Matthews asserts that in the musculature nearest the cervical mucosa small inflammatory foci or even small multiple abscesses may be found.

Moench chose twelve patients with subacute or definitely progressing chronic arthritis in whom other foci of infection had been eliminated, but whose symptoms bore evidence of the continued activity of a focus of infection within the body. A definite increase in specificity for joint tissues was apparent in animals inoculated from strains of streptococcus isolated from this group, as compared to that of streptococcus isolated from the cervix in unselected cases. Such tendency to joint localization in the former group was retained over three and four animal passages.

Bernhard Friedländer recently described the case of a young woman, who developed swelling and pain in the joints of her

hands, elbows, and shoulders following an abortion. There was a foul-smelling vaginal discharge. Examination of the cervix showed it to be chronically inflamed and hypertrophied, with a thick mucous discharge. Following a trachelorrhaphy the pain and swelling of the joints disappeared, and the patient was dismissed from observation in four weeks from the time of the operation in perfect condition.

